Prologue

Huntsville, Alabama was an unlikely location to lead America into space. A lost-in-time, sleepy village so typical of the Deep South, Huntsville of 1956 had its own black ghetto called Shantytown, but the terms "segregation" and "integration" hadn't yet intruded on anyone's attention. Certainly, I went to school with black kids for what seemed like the first time in my life, being tugged from Army post to Army post, a new one every summer. I truly believe my Alabama teachers hadn't gotten around to properly learning English—since no one spoke it correctly.

The Department of the Army had "requested and commanded" my father's presence at Redstone Arsenal. He was one of its few master missiliers for whom the Army had also paid for a state-of-the-art electrical engineering advanced degree. Having spent two years in Germany immediately following World War II, my father also had experience working with Germans displaced by the war. So, he was pulled away from the White Sands Missile Range to be name-requested to tutor a crusty two-star general pulled out of retirement to lead the Army's missile development team. Dad hoped General Medaris was not going to be yet another example of Pentagon REMF, neither a West Point graduate nor an artilleryman, for Christ's sake! And his German scientists were barely comprehensible. Dad told me a real German Baron was in charge of the team, and I asked Werner Magnus Maxmilian Baron von Braun why he talked funny. "Well," he told me, "I come from the south—Alabama." This made perfect sense to me as my own speech patterns evolved.

Like most military families, we took the Soviet threat of invasion seriously. The post commissary sold every family boxed military ration kits and canned water for stockpiling in our own makeshift bomb shelters at home. They tasted awful. The new Soviet First Secretary had just told the American ambassador, "We will bury you." The Russians were coming to invade Alabama, and we and our shelters were all that was stopping them.

So troubled in spirit, it is a wonder to me now that while the rest of America was digging backyard fallout shelters deep into the earth, for this brief period the men and women of this unlikely location sought to escape Earth for the glory of exploring space.

My father would find his pupil a fast learner, and he himself would be challenged to fully understand the problems faced by the Baron and the solutions the team resolved. In the days ahead, this timeless little village would be tested to see if it had the right stuff. The entire world would be watching, and it all began on September 20, 1956…

—David Kohler

The Year of the Race to Space Series

September 20, 1956

On this day 50 years ago, the world's first space launch vehicle (SLV) blasted into space and began a year-long race to space filled with heartache for the losers and triumph for the winners.

This launch, conducted by the US Army Ballistic Missile Agency (ABMA), tested the staging and sequential firing of three of the four stages of the Jupiter-C rocket. Taking the place of the inert fourth stage's fuel was 20 pounds of instrumentation and 10 pounds of sand, both carefully weighed to match the future weight of

Jupiter-C space launch vehicle fueled and ready.
—US Army photo

the Explorer satellite. Because the launch was completely successful, ABMA could have done a turnaround launch within 30 days—this time with a satellite. However, fate intervened because not all the participants of the race to space were evenly handicapped.

Six years before in March 1950, US scientists meeting in the house of physicist James Van Allen proposed an International Geophysical Year (IGY) for 1957-1958 to correspond with predicted peak sunspot activity. Aware that Soviet First Secretary Nikita Khrushchev planned to unveil a plan for Soviet IGY participation at an international convention of scientists, on July 29, 1955 President Dwight Eisenhower announced the US's IGY contribution of launching an artificial satellite. No American believed the Soviet announcement four days later was backed with science up to the challenge.

An advisory group met before and after the announcement to determine which military service would be selected to develop the US's rocket and satellite. Because funds and prestige were at stake, each of the US's military services submitted a proposal:

- The Army's proposal was to use a Redstone missile modified to have four stages. The fourth stage with engine would be the actual satellite, called Explorer, put into orbit.
- The Air Force proposed to use the Atlas intercontinental ballistic missile (ICBM) —still on the drawing boards.
- The Navy proposed building a three-stage rocket using a primary stage based on its Viking rocket, used to conduct scientific studies of the Earth's ionosphere in the 1940s.

Vanguard—the Eisenhower administration's choice to lead the US to space.
—US Navy photo

These proposals set the stage determining the contestants in the race to space—with the Soviet Union not considered a serious contender. The advisory panel voted seven to one to accept the Navy's proposal since the primary stage was not a weapon and the Eisenhower administration wanted to make clear the exploration of space should be peaceful. The panel also argued for national defense having priority over all other efforts, and space exploration should not hinder efforts to successfully test and develop either the Army's or the Air Force's missiles as weapons. Because the Navy was to lead the US into space, the Navy called the program Vanguard.

Neither the Air Force team nor the Army team was satisfied with this decision. Led by Major General John "Bruce" Medaris and including legendary missile developer Werner von Braun, the Army team was convinced the Navy did not have adequate expertise to succeed. Also, the Army was in a fight-to-the-finish with the Air Force to determine which would provide the nation's intermediate-range ballistic missiles (IRBM). The Air Force team, led by Major General Bernard "Bennie" Schriever, was better financed and included two major defense contractors: the Douglas Aircraft Corporation developing the Thor IRBM and the Convair Division of General Dynamics with missile designer Karel Bossart developing the Atlas ICBM.

The Navy team, managed by engineer John Hagan and also employing Martin Missiles, was under-funded and given lowest testing priority. From the beginning of the race, although the Vanguard Program was handicapped to be the winner, it had neither the Army's long years of development experience nor the Air Force's massive funding.

Interservice rivalries would plague the American teams and subject them to unproductive, manpower-wasting wrangling to justify their separate existences. Also hampering the US teams were the steps taken to isolate the classified efforts of missile development from the public and open development of the Vanguard Program. Although the Air Force and Army teams had access to Vanguard's successes and failures, it was a one-way street. Army contractor Chrysler was not sharing information with either Convair, Douglas, or Martin. Since Douglas was also in competition with Convair, US missile development was very compartmentalized.

Medaris, von Braun, and Brigadier General Holger Toftoy, commander Redstone Arsenal.

—US Army photo

The Soviet team, led by designer Sergei Korolev, lacked the United States' development experience but was mostly free of in-fighting and could devote a unitary effort toward getting into space. Even in Korolev's darkest days (explained later in the series), his rival did not withhold development information nor deplete the resources he needed.

Medaris disguised his test launch's intent by naming the rocket Jupiter-C since it was funded from the Jupiter IRBM Project. Although the rocket was clearly the modified Redstone proposed for consideration in 1955, it carried sand instead of a satellite. Euphoric after learning the rocket had almost reached orbital velocity even without its fourth stage engine, von Braun later argued with Medaris about publicizing this secret launch. Medaris, who would become a priest in 1960, told von Braun the pulpit joke about a preacher who for years had preached the sins of playing golf on Sundays instead of going to church. One Sunday the preacher was tempted by Satan to play golf himself. On his first stroke, he made a 200-yard hole-in-one. The message to von Braun was although the maiden voyage of the Jupiter-C was a hole-in-one, secrecy about trespassing on Vanguard turf would prevent him from telling about it.

Since too many proud rocketeers knew of it, the event was leaked to the press. After the leak, Korolev would raise the alarm the Americans were winning the space race while Soviet emphasis was too strongly on the arms race. To avoid being cancelled, Jupiter's arch-rival Thor went into high gear to rush development. Finally, Atlas development was further speeded up because of Korolev's increased tempo.

The real Jupiter missile.

—US Army photo

In each month following this September event, all five competitors would jockey back and forth for the lead in the race. The "right stuff" of the world's foremost rocket design teams would be tested with months of 18-hour workdays while the governments of each hamstrung them with limiting policy and public commitments proving difficult for the engineers to deliver. Ultimately, the national defense and the international prestige of the world's two largest superpowers would be put at stake. As a result, the technology created by this challenge would propel the world into the Information Age.

The race was on.

Next Month: How the goal of the space race was shaped by the arms race.

The Jupiter-C's forerunner, the Army's Redstone ballistic missile.
—US Army photo

October 1, 1956

On this day in history 50 years ago the United States entered into a new fiscal year. Now with a finite budget, the US participants in the race to space were no longer free to add expensive modifications to their plans proposed more than a year ago for launch during the International Geophysical Year (IGY) of 1957-1958. The most expensive component, the space launch vehicle (SLV), was now locked in.

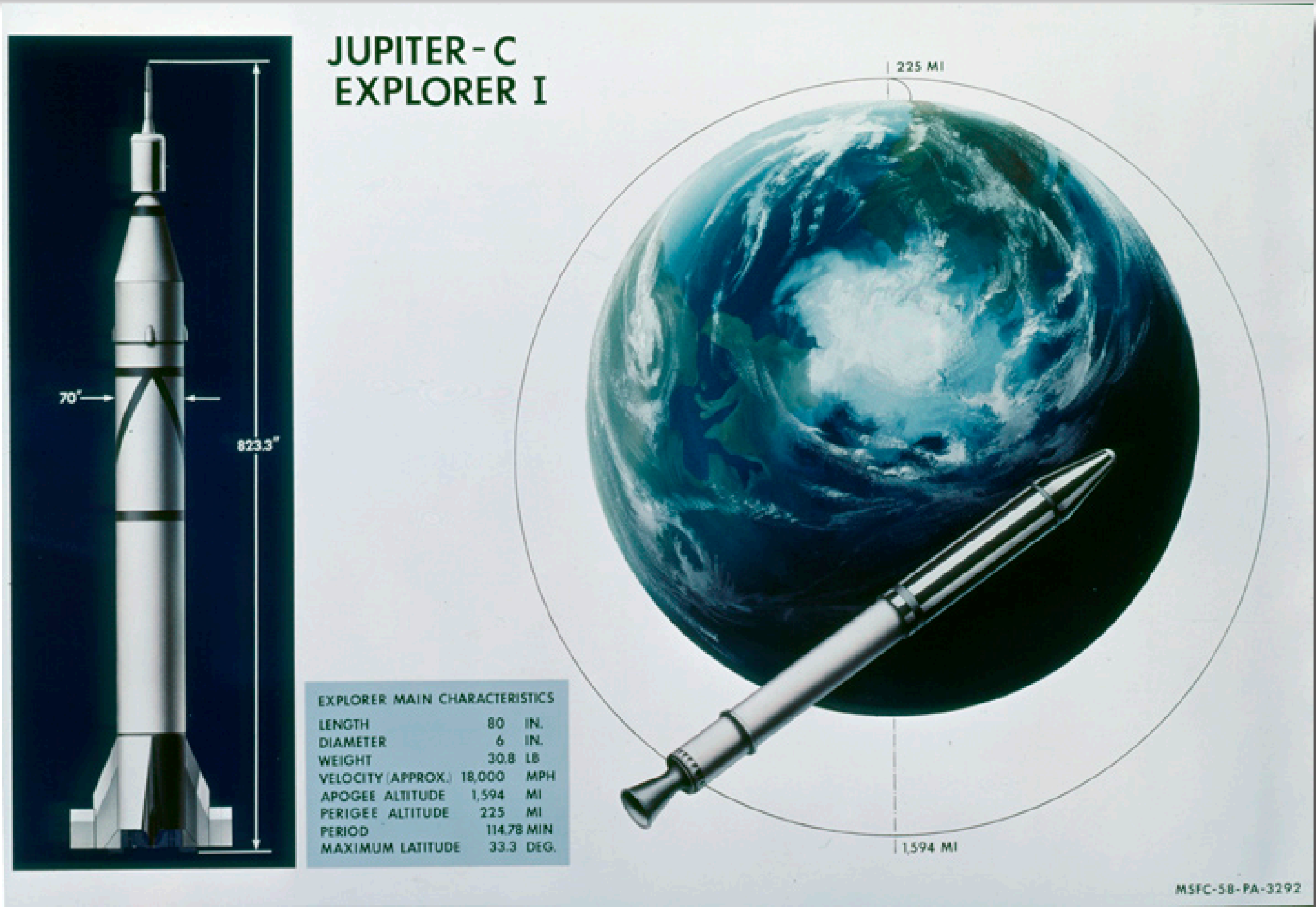
Until now, no one in the US government viewed the race to space as a race or as being particularly important. Every rocket designer fully believed the US taxpayer would revolt at paying the high cost of rocket development for what most perceived to be only a propaganda payoff.

However, the United States and the Soviet Union were already locked in a deadly arms race. At stake was the best delivery system for atomic bombs to the other side, and both sides believed the winner of the arms race would initiate a ground war before the loser could gain parity. Until 1955, the United States believed its B-52 bombers, which could strike Moscow, gave the US an edge. In 1955, intelligence coming out of the Soviet Union told the story of a massive missile recently approved for development by the Soviet Council of Ministers. This threw the US Air Force into a panic, heated up development of the dormant plans for the Atlas missile, and made massive funding available for it and for an alternative missile called the Titan. Military development of an intercontinental ballistic missile became the cash-eating national defense priority.

Soviet Union officials announce their intention to launch a satellite during IGY.
—NASA photo

It is one thing to build a weapon with the intention of using it and another thing altogether to build it as a deterrent from invasion. Having a deterrent has no value unless the other side knows you have it. So began an information war of nerves, the Cold War, where the value of missile development information given to the World's media had almost the same value as having the weapon.

The race to space, an attempt to peacefully exploit space, was itself a weapon of the Cold War. In pre-empting the Soviet IGY announcement of sending a satellite to space, the US won the opening propaganda battle. In making the Vanguard Program open to the public, Eisenhower could both gain public acceptance of the development cost and not be hindered by the public release constraints put on classified missile development. In contrast, the Soviet Union did not have to justify to its citizens the funds spent on going to space, and it felt no compelling need to make public announcements of its progress.



The Jupiter-C SLV shown with the fourth stage Explorer satellite and its first orbit.
—US Army illustration

The size of space race's SLV entry locked in the size and weight of its satellite. The US Army's Jupiter-C SLV, essentially unchanged outwardly since its proposal in 1955, had postulated the SLV's fourth stage with rocket engine would be the Explorer satellite with an interior equipment bay capable of a 5-pound scientific package. A year later, improvements in guidance and engine design had cut deadweight to now allow a 50-pound package within the same fourth stage housing.

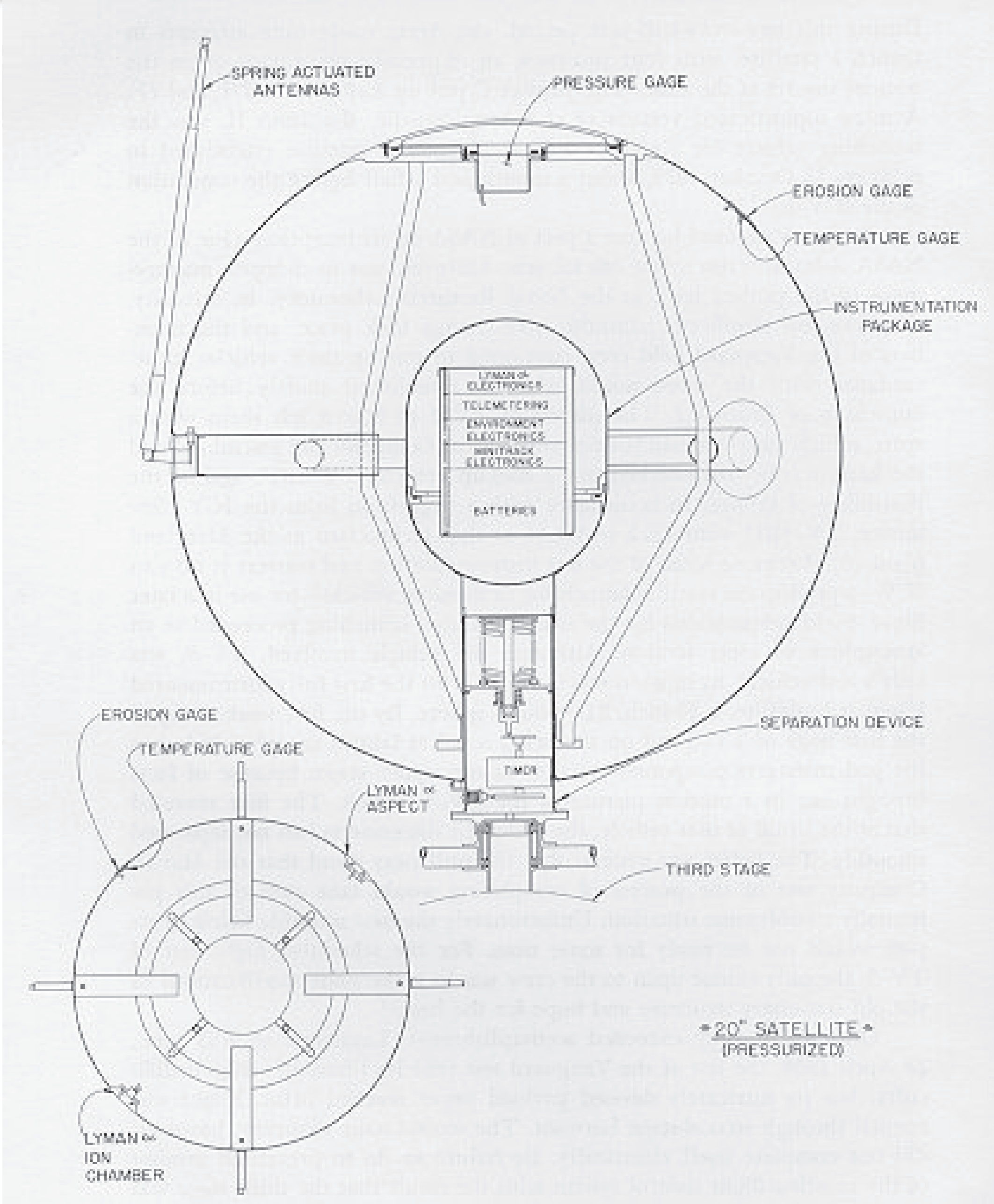
But scientists had rejected the Army's entrant for three practical reasons:

- The design of the four stages seemed to allow no room for future growth. Five pounds was too small for the future-thinking scientists who had already mapped out the weight requirements for the first five satellites.

• Spacelift is a balance of payload weight and orbit height against available rocket engine thrust. The injection orbit of the Army's SLV was lower than desired and would result in the satellite falling back to Earth in too short a time.

• The cylinder-shaped fourth stage was too narrow to be optically tracked. While the plan was to have satellites send radio signals to the ground and to track on those, the size and weight of batteries ensured the satellite would have a short life. A spherical satellite could reflect light better and be large enough to be seen by optical telescopes.

On the other hand, the chosen Vanguard SLV was planned to have sufficient thrust as to allow a 30-pound scientific package housed in a 20-pound, 20-inch ball being



Naval Research Laboratory illustration of the Vanguard 20-inch satellite with initial experiment package.

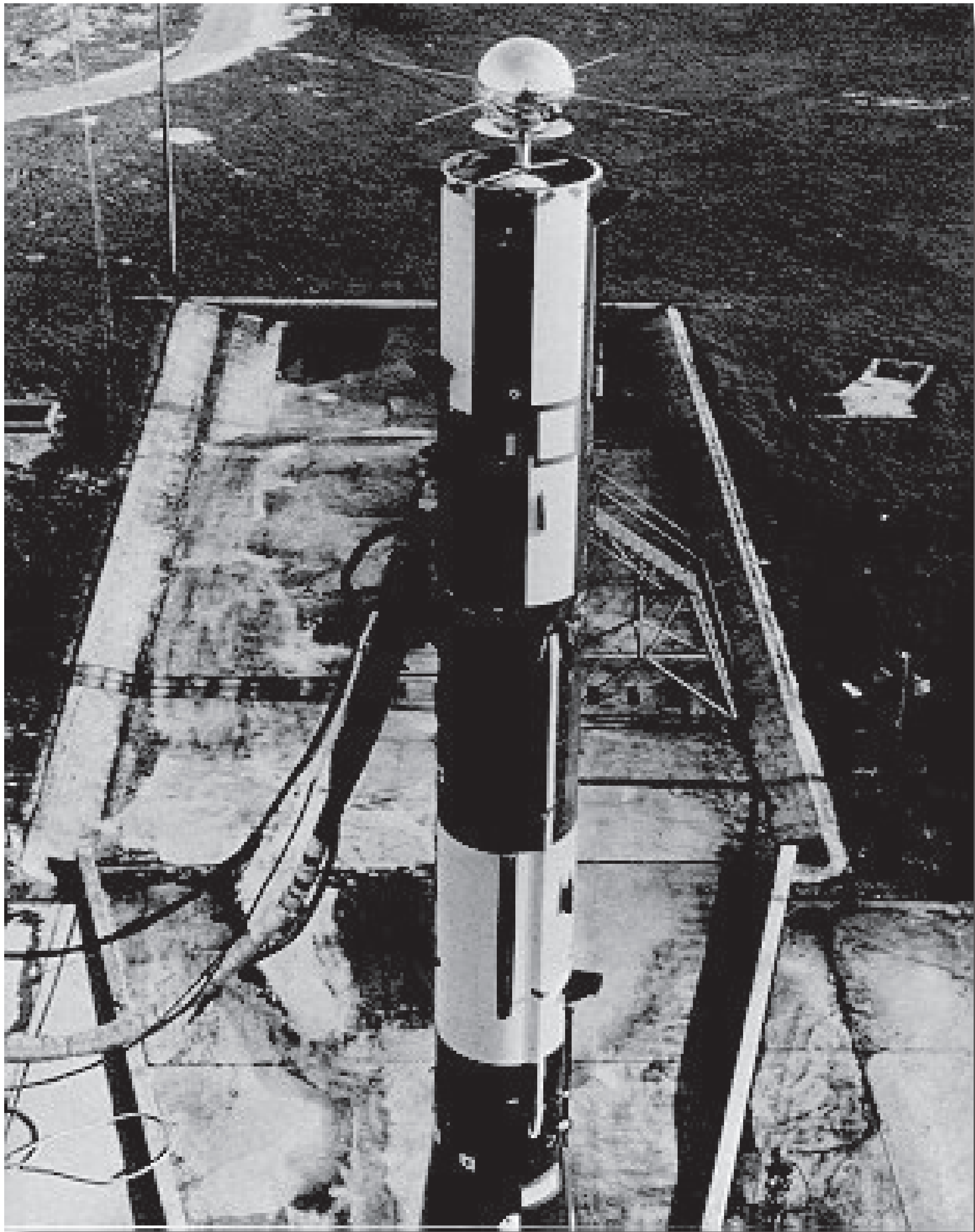
—US Navy illustration

injected into a much higher orbit with a corresponding longer useful life. Further, the satellite would use transistorized electronic circuit boards powered by solar cells located on the skin of the satellite. All-in-all, the Army entrant lacked the pizzazz being promised for Vanguard.

As events were to prove, promising is not delivering. On October 1, 1956, the Vanguard scientific package still had these hurdles to overcome:

• The rocket engine's promised thrust had yet to be delivered. The scientific package design committee, hedging their bets, redesigned Vanguard's package to a 5- and a 10-pound weight with a corresponding change in the satellite's diameter as a contingency to ensure having any satellite at all for IGY.

• Solar cell technology was untested and unproven. No one really

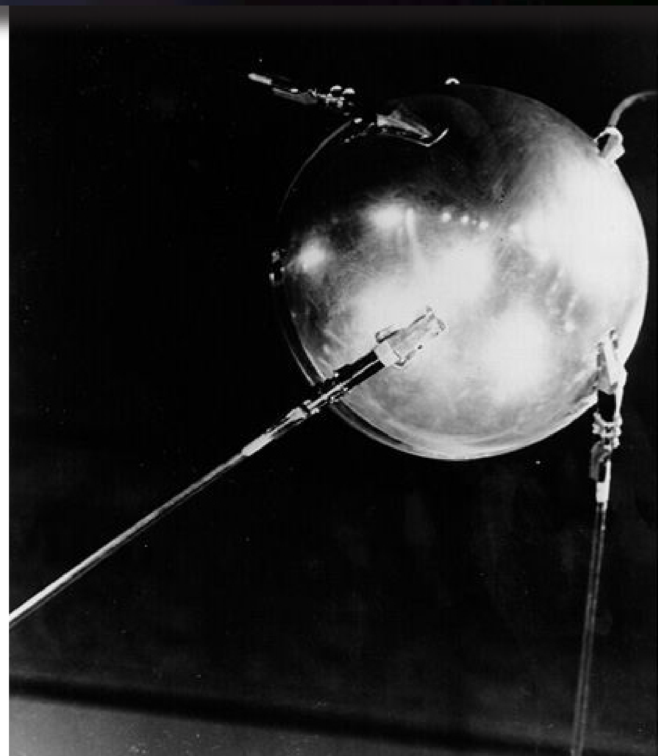


The 20-inch Vanguard satellite with antennas extended during assembly.
—US Navy photo

knew if the cells would perform properly in space. While the Vanguard testing protocol was scheduled to test them in space before orbiting a satellite, the delays of not having the necessary thrust could mean not having sufficient time to conduct the test.

- Transistors operate in a narrow temperature range. Without first using a satellite to measure the temperature of space, no one knew if the provisions to control the interior temperature of the satellite could guarantee a usable temperature. This also argued for testing in space prior to orbiting a satellite.

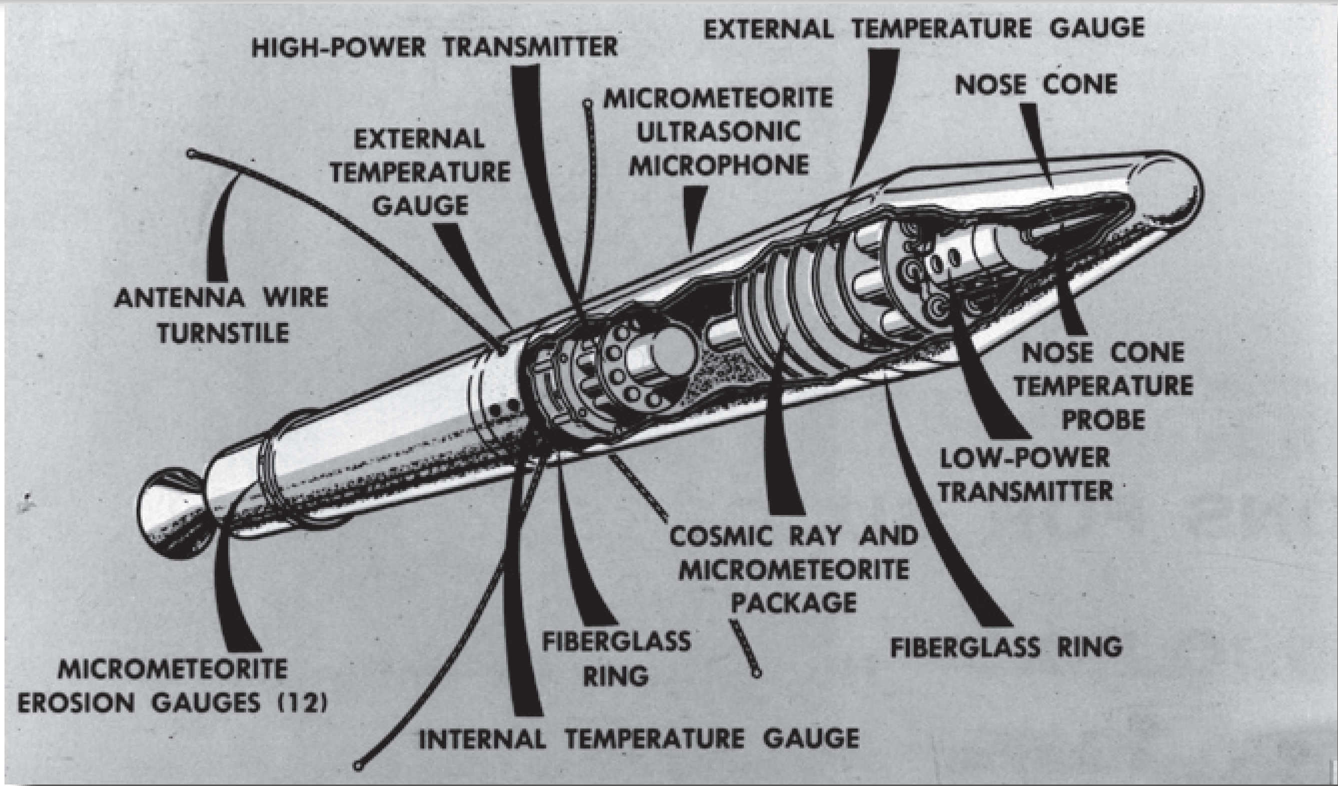
Meanwhile, the dark horse Soviet entry into the space race was unconstrained by the limitations of weight. The "massive missile" of 1955 intelligence reports was postulated to lift a 3,500-pound atomic bomb 8,000 miles. With its 22.5-inch diameter, the Soviet satellite, called Sputnik,



Sputnik 1 showing the outer sphere and pressurized inner sphere with battery case and transmitter.
—NASA photos

was the same size as Vanguard. However, it was very different in these ways:

- Sputnik weighed 184 pounds. Inside it was a sphere within a sphere. The inner instrumentation sphere contained nitrogen under pressure as an experiment to measure micrometeoroid impact and to provide temperature control.
- Without advantages of component miniaturization and solar cells— but free from weight considerations—much of the interior was taken up by three silver-zinc batteries weighing 112 pounds of the total weight.
- The two transmitters used two different frequencies with neither approved by the international scientific community. However, both were easily received by the world's amateur radio operators.



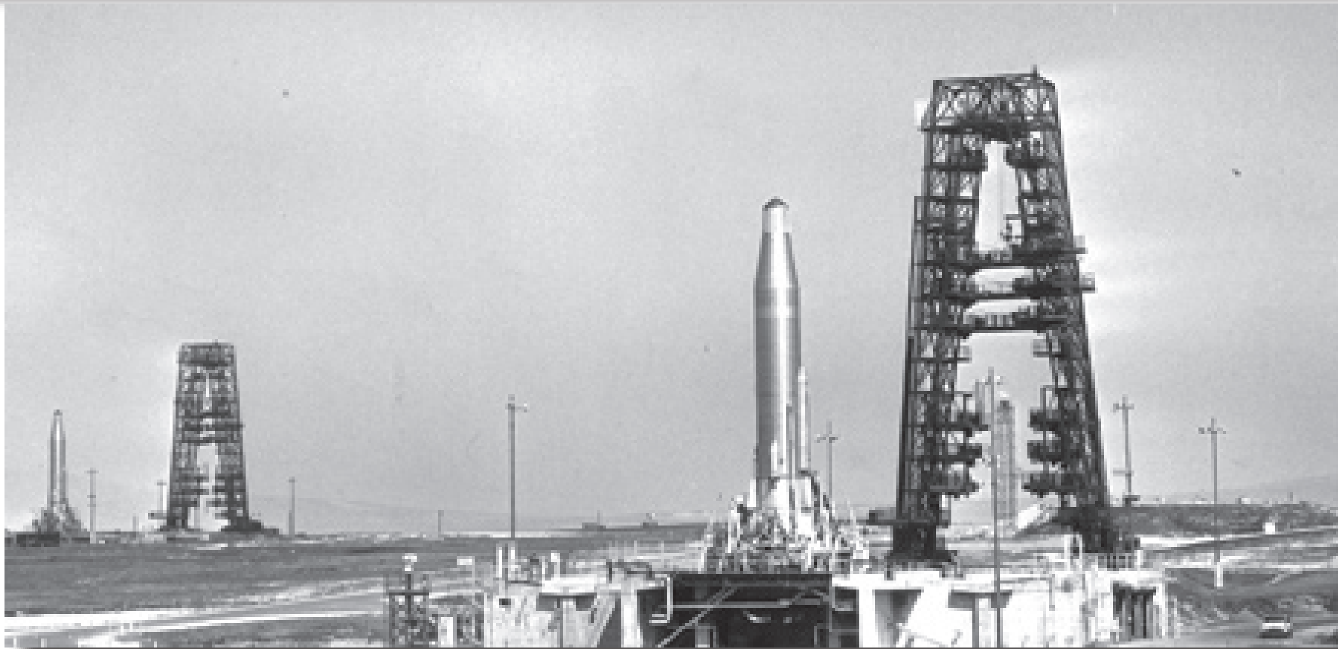
Jupiter-C's Explorer 1 final scientific package.

—US Army illustration

Having successfully tested its Jupiter-C SLV previous month, the US Army was ready to move ahead and design the scientific package for its fourth stage. Head of the Army's research team, Dr. Ernst Stuhlinger, had attended graduate school with the designer of the scientific package for Vanguard, Dr. James van Allan. Working in the background with Dr. William Pickering of the Jet Propulsion Laboratory in California, the three considered the optimum package that would fit in Jupiter-C's fourth stage.

Next Month: How the establishment of Vandenberg Air Force Base increased the tempo of the race to space.

November 16,1956



Atlas-D ICBMs and their erection towers at Vandenberg Air Force Base, October 1962.

—US Air Force photo

On this day 50 years ago, The Department of Defense transferred 64,000 acres from the US Army's Camp Cooke on the central California coast to the US Air Force to be used as the nation's first intercontinental ballistic missile (ICBM) base, eventually renaming it Vandenberg Air Force Base. This Cold War announcement was to remind the Soviet Union of the Air Force's commitment to speed up Atlas ICBM development, which prior to that date had only been fired for 4 seconds on a captive test stand. This event was followed seven months later by the announcement of the standup of the 704th Strategic Missile Wing to man the Vandenberg site.

The previous September's maiden space voyage of the Jupiter-C space launch vehicle (SLV), leaked to the press, was now causing concern in the Soviet Union. Soviet rocket designer Sergei Korolev was already preparing a proposal for a Soviet preemptive satellite launch within the next 12 months. However, the news about Atlas suggested the missile was closer to initial operational capability than previously suspected. The Soviet Council of Ministers compelled Korolev to temporarily abandon the production of the satellite mating collar for the rocket. With each coming month, the tempo of the race to space increased.

The approaches of the race's participants were dictated by pre-race handicapping:

• The US Army team already had an SLV and were awaiting permission to use it. It had been carefully developed over a 4-year period using an ultraconservative engineering process that tested individual rocket components, then tested individual assembled systems, then tested the combined systems as the complete rocket. Using a secret new calculating machine called a computer, data from each component and system test was used to build data models predicting how the unit would react under different operating conditions. Because the predictions were only as good as the data, the process had to be slow to build accurate models.

• Vanguard's US Navy team initially adopted the Army's approach because it gave successful results. However, early in Vanguard development it became clear the original design was insufficient to produce the thrust necessary to reach orbit. All three Vanguard stages would have to be completely redesigned. Not given priority status, Martin Missiles could not meet program deadlines, and the projected launch date kept slipping. The slow approach would have to be abandoned in favor of skipping test steps if the satellite launch deadline was to be met.

• The US Air Force's Thor team was threatened by the Army team's progress with Jupiter, and the 4-year head start of the Army team was proving difficult to overcome. Originally designed without sufficient thrust to put a satellite into orbit, Thor could certainly be made more attractive if it could be repackaged as the first stage of an SLV. Like for Vanguard, the Thor team would have to abandon exhaustive testing in order to make up for joining the race late.

• The US Air Force's Atlas team did not consider itself in a race to space, but it knew it was in an arms race to develop the world's first intercontinental

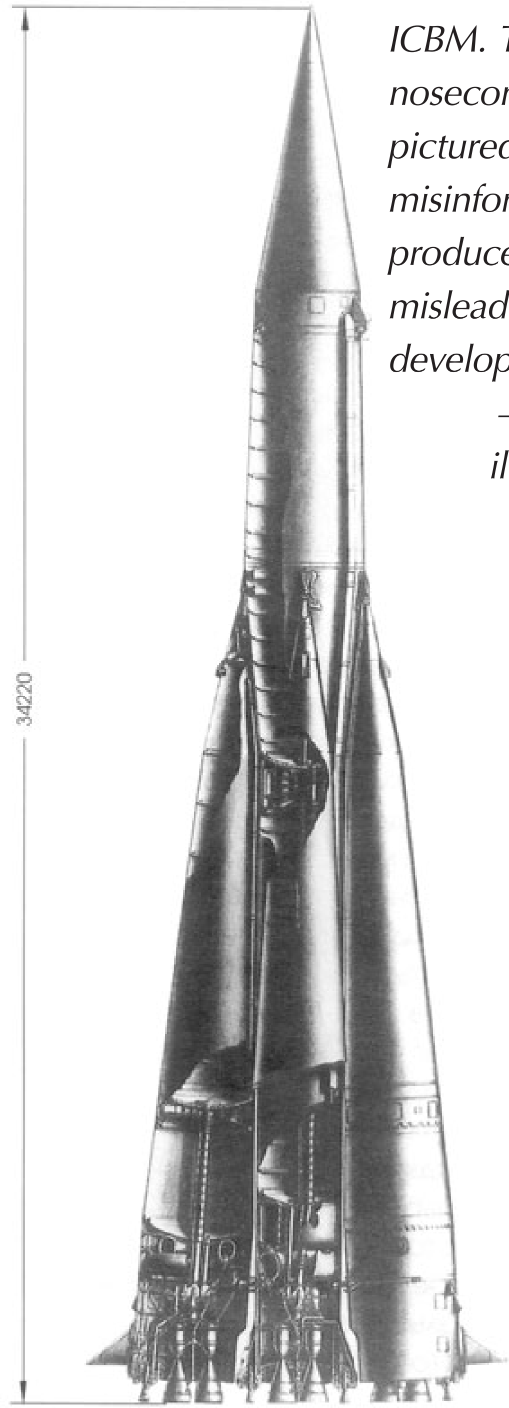
Atlas-D at Cape Canaveral in May 1959.
—US Air Force photo

ballistic missile (ICBM). Karel "Charlie" Bossart's brilliant design for Atlas, put on hold by the Air Force from 1948 to 1955, made it a late race entrant. Like Thor, Atlas was feeling the pressure of program cancellation—in favor of competitor Martin Missile's Titan—if it could not deliver in the Cold War battle for the United States to become the first superpower with an ICBM.

• As the underdogs in the American mind, the Soviet team was mindful of the Cold War value for beating the Americans into space and for producing the world's first ICBM. No attempt was ever made to copy the slow approach. Rather, the Soviet approach was to achieve noteworthy development milestones quickly through massive, concentrated effort, then to move to the next milestone with minimal continued testing.

National policies and the arms race further influenced the flow of information necessary for rocket development. The Soviets presented a massive question mark in the minds of the West. With free information flow among the Soviet scientists and developers working on rockets, there was unitary Soviet effort that led to faster problem solving. However, development was conducted at two top-secret locations hidden from everyone but the development teams, and public information about Soviet progress was understated in its state-controlled press.

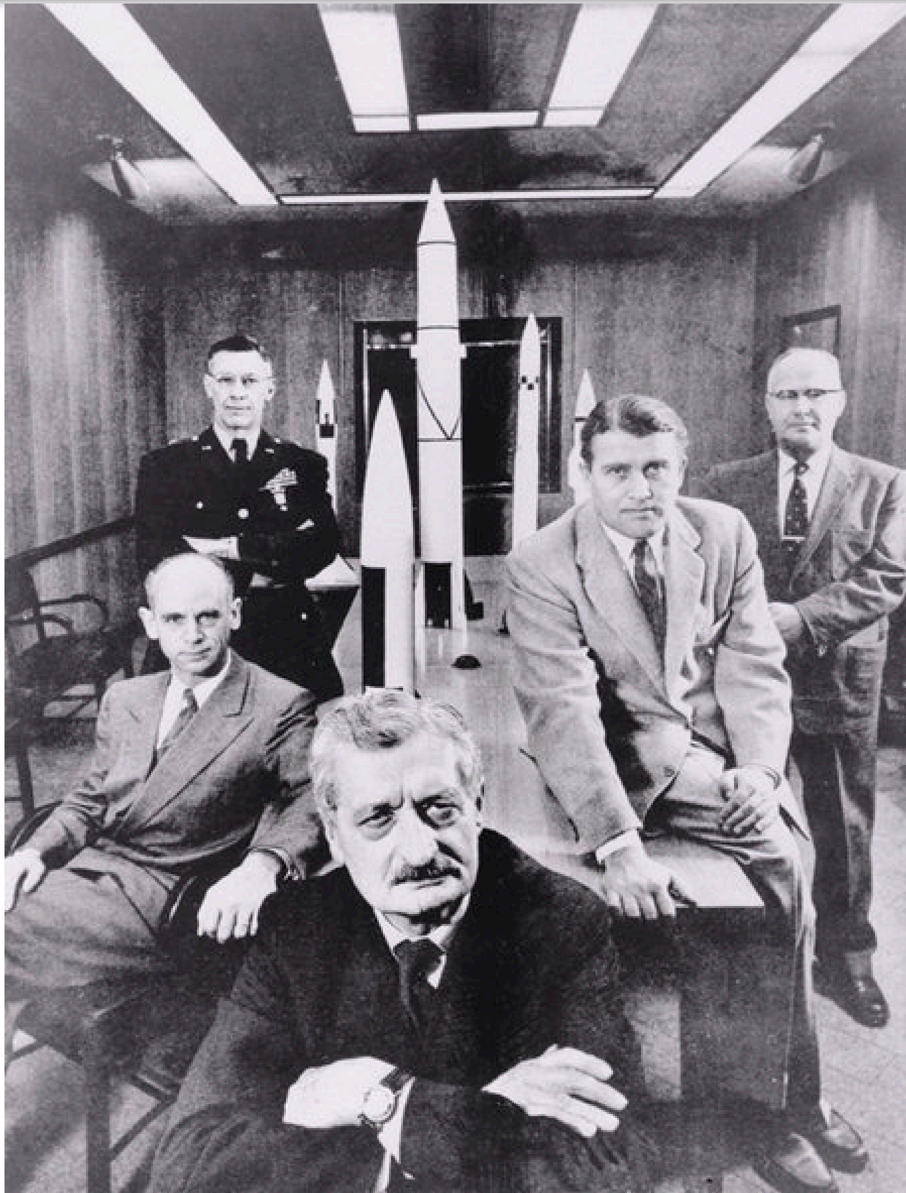
The United States also classified missile development, but this created an information gap between the developers who had access to the information and the scientific community who did not. Further, interservice rivalry and the close-holding of corporate secrets



The Soviet R-7 ICBM. The nosecone as pictured is misinformation produced to mislead Western developers.
—Energia illustration

would impede the flow of information and isolate the American teams from each other.

The leader of the Army team, Major General John "Bruce" Medaris, would later openly criticize how interservice misinformation led to all kinds of public problems. He constantly complained the military news releases coming from Cape Canaveral would overstate—and invent—"successes" that were the opposite. As soon as one service would proclaim a successful test, the other services would leak the discrediting truth. This made it almost impossible for the separate military programs to learn from each other. A week earlier than the Cooke land transfer, he published what became known as the Dagger Report, which openly questioned the Eisenhower administration's rationale for suppressing superior Army rocket



A rare US Army press release photo taken for Life Magazine Feb 1956. From left to right, Redstone Arsenal commander Brigadier General Holger Toftoy, Research Division head Ernst Stuhlinger, father of Germany rocketry Hermann Oberst, Development Division head Werner von Braun, and engineer Robert Lusser.
— US Army photo

achievements in the face of Air Force and Navy failures. In response, Department of Defense Secretary Charles Wilson issued the Wilson Memorandum on November 26th that came close to shutting down the Army's Jupiter Program—the program footing the bill for the US's only successful SLV to date.

When asked a year later why the Army team was so successful with the Jupiter-C, developer Werner von Braun said the old hands of the Army team had been practicing rocketry for 12 years longer than any other team and had superior data models. However, in 1961 history will record while von Braun was conducting one last careful test on the US Mercury space capsule with a monkey, the Soviets preempted Alan Shepard's place in history by sending Yuri Gagarin into space first.

Next Month: The Army team becomes the odds-on favorite.

ВЕЛИКОЕ СОБЫТИЕ В ИСТОРИИ ЧЕЛОВЕ

ПРАВДА

13

К КОММУНИСТИЧЕСКОЙ ПАРТИИ И НАРОДАМ СОВЕТСКОГО СОЮЗА! К НАРОДАМ И ПРАВИТЕЛЬСТВАМ ВСЕХ СТРАН! КО ВСЕМУ ПРОГРЕССИВНОМУ ЧЕЛОВЕЧЕСТВУ!

ПЕРВОМУ КОСМОНАВТУ— ЧЕСТЬ И СЛАВА!

СССР

Alan Shepard waits in the capsule while Pravada announces sending the first man into space.

—NASA Shepard photo

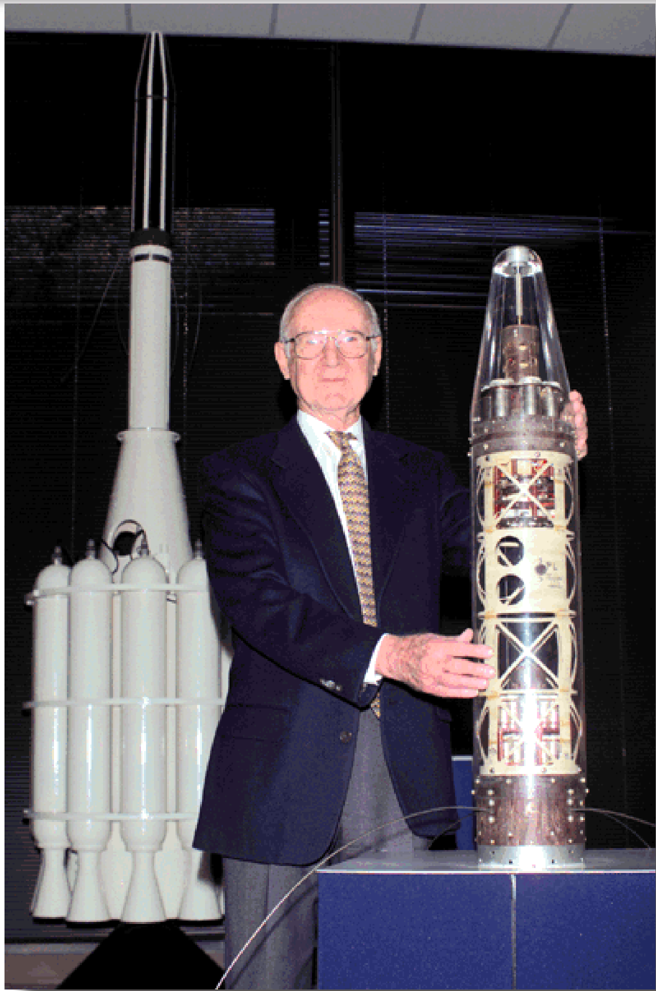
—Pravada page © Anatoly Zak

December 19, 1956

On this day 50 years ago, the Army Ballistic Missile Agency (ABMA) successfully tested a single stage modified Redstone missile using a souped-up new rocket fuel called Hydyne. This test followed a November 29th launch to test a new guidance system on the Jupiter-C space launch vehicle (SLV) which reduced overall rocket weight and greatly improved guidance accuracy. Prior to the test, the circular error probable (CEP)—a measure of how accurately the reentry vehicle lands—was usually measured in tens of thousands of meters. The test itself had a CEP of only 255 meters and subsequent tests gave similar error ranges. Also, Hydyne gave enough thrust to raise the potential scientific package weight from 5 pounds to 30 pounds.

Pertinent to the space race, a strong criticism of the Jupiter-C SLV was its upper stage "guidance" system. Guidance systems were heavy, and to put one on each of the four stages would increase the SLV's weight beyond its ability to carry a satellite. To solve this problem, designer Werner von Braun mounted the top three stages of the SLV within a spinning tub. The spin given to each stage would keep each stage pointed in the same direction even though the second and third stages had multiple engines that could burn at different rates. With only a single guidance system on the primary stage, accurate orbital insertion did not appear likely.

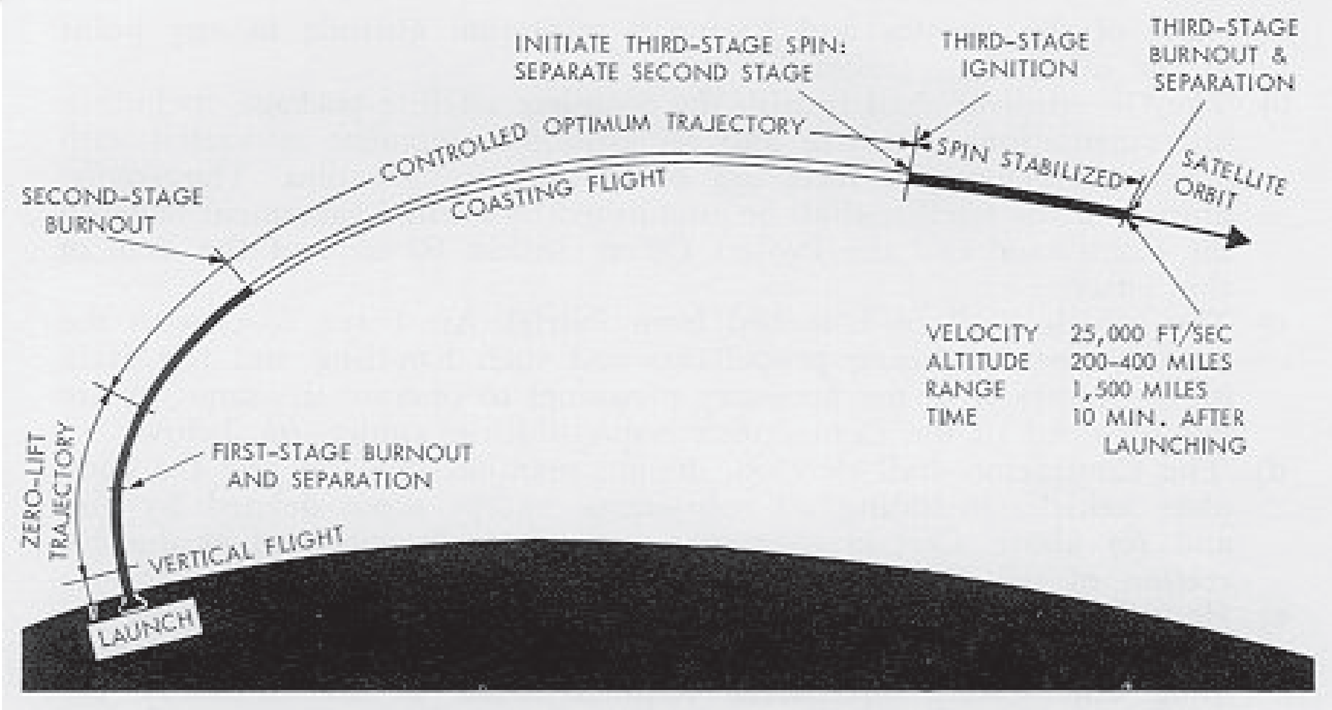
Also having to be weight-conscious, Vanguard elected to put a separate guidance system on the first and second stages, but it also planned to use a spinning table to rotate and "point" the



Jet Propulsion Laboratory Director Dr. William Pickering with a full scale model of the Explorer 1 satellite. In the background are the second, third, and fourth stages of the Jupiter-C SLV that were placed in the spinning tub.

—NASA photo

third stage. For the Jupiter, the guidance system pointed the rocket parallel to Earth prior to firing the second stage. Vanguard's extra postulated thrust would rotate the missile horizontal to Earth prior to firing the third stage. Both rockets made use of the Earth's rotation to add speed to the rocket and place it in a higher orbit.



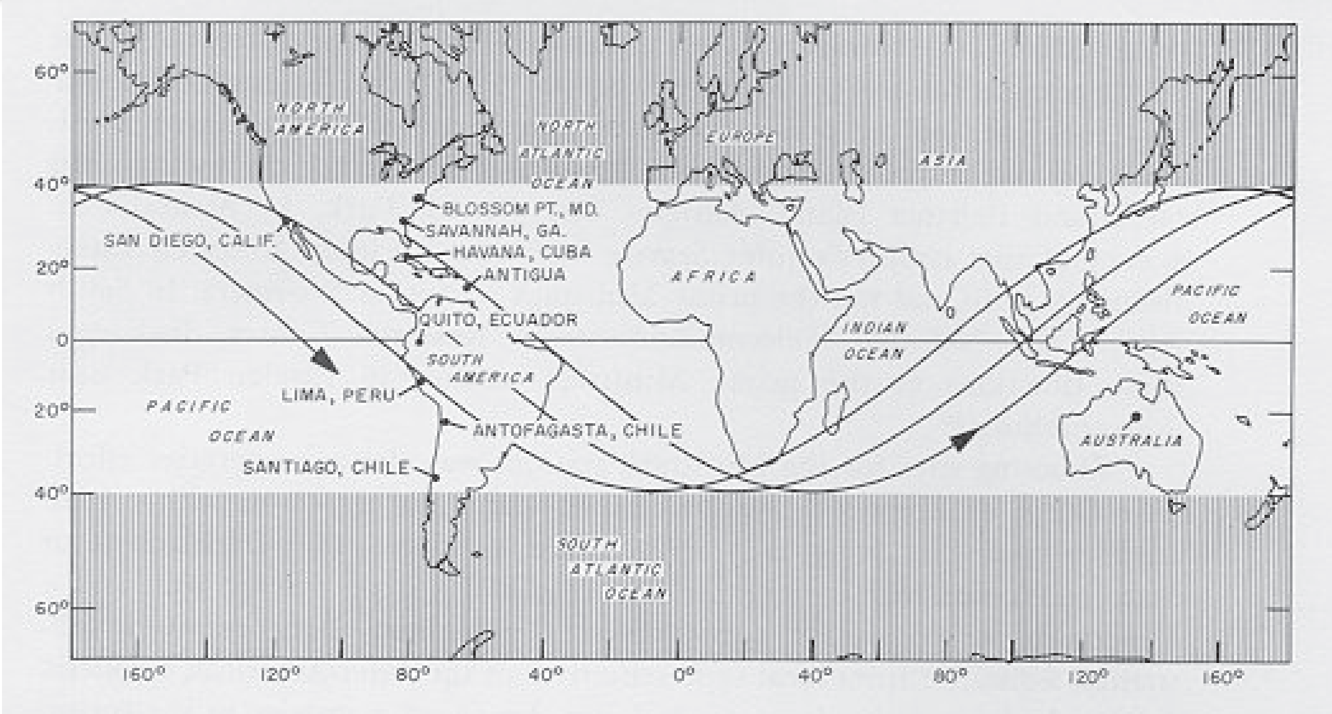
The Naval Research Laboratory's plan for Vanguard's staging and orbital insertion.

—US Navy illustration

The two different designs meant the primary Jupiter-C stage had to be five times as accurate as the Navy's Vanguard. The new design ensured this accuracy, and it made the Jupiter intermediate-range ballistic missile the most accurate missile in the US's inventory for the next 10 years.

The Army's successes were a tribute to the Research Division of ABMA. Represented at the top by ABMA's head, Major General John "Bruce" Medaris, the Research Division normally was overshadowed by the Development Division headed by von Braun. However, the Research Division, adopting a slogan of "No general can excel if given faulty intel[ligence]," allowed workers to admit their mistakes and report honest results. During this period, a malfunctioning rocket postmortem identified guidance system failure, and von Braun requested the Research Division to do an extensive redesign of the system. One of von Braun's engineers stepped forward two days later and explained he had over-tightened a screw when mounting the unit and had witnessed a spark. Von Braun cancelled the redesign request, thus saving months of rework and new test launches, sent the engineer an expensive bottle of champagne, and very publicly acknowledged the author of the Research Division slogan. It remained on his desk during his tenure at NASA.

Meanwhile, on December 8th, the Navy successfully completed its first free flight test of the Vanguard legacy first stage. Designated TV-0 (TV for test vehicle), the first stage proved able to transmit data to a ground station. An important legacy of the Navy's Vanguard program was the development of a pole-to-pole line of satellite tracking stations called Minitrack. Each satellite was designed to transmit measurement data, called telemetry, back to Earth. Because of Earth's curvature and because the ground receiving station had to be in a direct line with the satellite, many receiving stations were required or the satellite's data could not be received and stored.



The Naval Research Laboratory's Minitrack system. On a rough north-south line, most of the satellite's orbit would have no ground receiving stations to record satellite data. A month prior to launching, the Army rushed augmentation stations to Nigeria and Singapore.

—US Navy illustration

Receiving stations also played a very important tracking role. In the same way you can know exactly where you are on the Earth with a GPS unit receiving the signals from several satellites, scientists could use several fixed ground stations to determine exactly where a moving, transmitting satellite was. These stations had to use exactly the same measuring equipment in order for the distance to be accurately determined. This measurement could be so precise that the exact shape of the Earth could be determined from the orbit of the satellite.

Only after orbiting the first satellites did scientists learn the Earth is not a perfect sphere—rather the North Pole sticks out and the South Pole sticks in, making the Earth not truly round.

Because the US's teams worked independently from each other, the US Army's Jet Propulsion Laboratory developed a separate tracking system. The only thing the two systems had in common was to use the transmission frequency and broadcasting channels specified by the international scientific community. Later, both systems had to be hastily modified to receive the different transmission frequencies of the Soviet satellite.

Next Month: The Air Force attempts to knock the Army out of the Race to Space.

January 25, 1957

On this day 50 years ago, the Year of the Space Race opened with the first attempted launch of the US Air Force's Thor intermediate-range ballistic missile (IRBM). Alarmed at the US Army's progress with the Jupiter's guidance system and its recent successful launchings, competitor Thor was rushed from the static test stand to its specially constructed pad for its first free launch. The role planned for Thor was to airlift it to Great Britain, where its range could reach Moscow. The threat of a deployed Thor would buy time for the completion of the Atlas intercontinental ballistic missile planned to be based at Vandenberg Air Force Base in California.

The missile, designated with the skin number of 101, rose six inches above the launch ring of its pad before fuel contamination destroyed a liquid oxygen fuel valve, causing the missile to lose thrust. It slowly fell backward on the launch ring and exploded spectacularly destroying itself and the launch facility.

The next three launch attempts of Thor during the following eight months of the Year of the Space Race similarly failed. The best performance of the four resulted in its being destroyed by the range officer after 92 seconds of flight when its guidance system failed and the missile headed back toward Earth.

One week earlier the Army successfully tested its modified Jupiter IRBM guidance system to prove it could accurately deliver a warhead if subjected to the most difficult short-range trajectory: an extreme altitude-to-range ratio. The missile was only 400 meters off-target.

Thor IRBM being tested at Vandenberg Air Force Base, April 1959.
—US Air Force photo

The competition of the Thor IRBM produced by Douglas Aircraft for the Air Force against the Jupiter IRBM produced as a joint effort between Chrysler and the Army Ballistic Missile Agency (ABMA) would continue through the year. Department of Defense Secretary Charles Wilson had already decided Thor should be the IRBM design to go forward, but unsuccessful tests of Thor made it impossible to cancel the Army's Jupiter program. Indecision would outlast Secretary Wilson and would continue the following year with the newly designated secretary, Neil McElroy, who would end his tenure with Jupiter and Thor still in competition with each other.

The ill-fated Jupiter IRBM as delivered to its Air Force customer, complete with clam shell protective base covering.

—US Army photo

The Thor launch site was located adjacent to the Jupiter launch site at Cape Canaveral. Three months earlier a failed Jupiter-A launch had gone horizontal at an altitude of 300 feet and was headed in the direction of the Thor launch site before a range safety officer blew it up in flight. Jupiter missile development head, Major General John "Bruce" Medaris, would later be teased both for trying to sabotage the Thor site and for lacking an accurate guidance system to succeed.

Arguing with Secretary Wilson for the continued funding of the Jupiter program, Medaris had implanted an Army liaison officer within the Air Force effort who reported Thor and Atlas development efforts directly to him. Medaris would later brag that he was kept better informed of Douglas Aircraft's progress than his Air Force counterpart, Major General Bernard "Bennie" Schriever, working at the Air Force's Ballistic Missile Division located in Santa Monica, California. Later in August, during new hearings threatening to cancel Jupiter funding, Medaris' inside man went toe-to-toe with Schriever's technical staff and routed them with his insider's knowledge. At stake was the continued survival of the Jupiter-C space launch vehicle. Canceling Jupiter would take the Army out of the space race.

General Bernard "Bennie" Schriever shown here with models of the various Atlas and Thor rockets used for spacelift.

—US Air Force photo

Ultimately, General Schriever proved too sly for Medaris. In order for ABMA to continue developing the Jupiter IRBM, the Air Force would have to accept it as its end customer. During a combined Air Force-Army IRBM program meeting, the Air Force purposely provided false missile specifications which resulted in the Jupiter being built 9 inches too large in diameter to fit into the Air Force's C-124 cargo plane built by—you guessed it—the Douglas Aircraft Company. After three years of interservice warfare spanning the administrations of two secretaries of defense, General Schriever would recommend rejecting the Jupiter since the Air Force could not airlift the missile to forward deployments.

"Old Shakey," the Douglas C-124 Globemaster II in 1957.
—Air Force photo

Meanwhile, the Soviet Union, unhampered by such interservice rivalries, surged ahead in the space race. On January 5th, Soviet rocket designer Sergei Korolev sent a detailed milestone plan pushing up the projected satellite launch date to June, before the beginning of the International Geophysical Year. Proving misinformation is effective, Korolev's distorted report said:

"In September 1956 the USA attempted to launch a three-stage missile with a satellite…which was kept secret. The Americans failed to launch the satellite… and the payload flew about 3,000 miles…. This flight was then publicized

in the press as a national record. They emphasized that US rockets can fly higher and farther than all the rockets in the world, including Soviet rockets. From separate printed reports, it is known that the USA is preparing in the nearest months a new attempt to launch a satellite and is willing to pay any price to achieve this priority."

Korolev's plan was approved on the same day as the failed Thor launch. It included a completely redesigned satellite. The original proposal called for a 2,500-pound satellite containing 500 pounds of scientific experiments. Deadlines passed without any progress on constructing it, and bench tests of Korolev's engines did not deliver the thrust necessary to put such a massive object into orbit. With American unclassified Vanguard reports detailing its 25-pound satellite, Korolev now could persuasively argue for a much smaller satellite in order to meet deadlines. The first milestone in his plan was a free flight test of his rocket design in April.

Next Month: The revolutionary design of Korolev's R-7 rocket.

February 24, 1957

On this day 50 years ago, the Year of the Space Race saw the completion of component fabrication of the innovative and technologically difficult clustered engine rocket, the Soviet's R-7. A working clustered engine design was a major step in developing sufficient thrust to send large payloads, such as the Apollo capsule that went to the Moon, beyond Earth's pull of gravity. Soviet R-7 designer Sergei Korolev would package up these components and send them off by train to arrive at the top secret location of the Baikonur Cosmodrome on March 3rd for free flight testing.

Both the United States and the Soviet Union had their rocket designs hampered by a bureaucratic infrastructure that dated back to the Roman Empire. The construction of the rocket engines and rocket bodies in both countries was done in manufacturing plants located some distance from where the missiles would be launched. Both rail and truck transportation systems use a right-of-way track or road bed based on measurements dating to the requirements of the Roman Empire. Considered the world's best road builders, the Romans standardized road width based on a chariot wheelbase of 4 feet, 8.5 inches, or the width of two horses abreast. This wheelbase resulted in wheel ruts spaced the same width in the road base. A wheelbase that deviated from the rut spacing would go in and out the ruts causing axle breakage, so 4 feet, 8.5 inches was standardized for road lanes. The standard railroad gauge is exactly the same distance; consequently railroad freight flatbeds are not much wider and neither is the trackbed right-of-way—especially through tunnels. Until

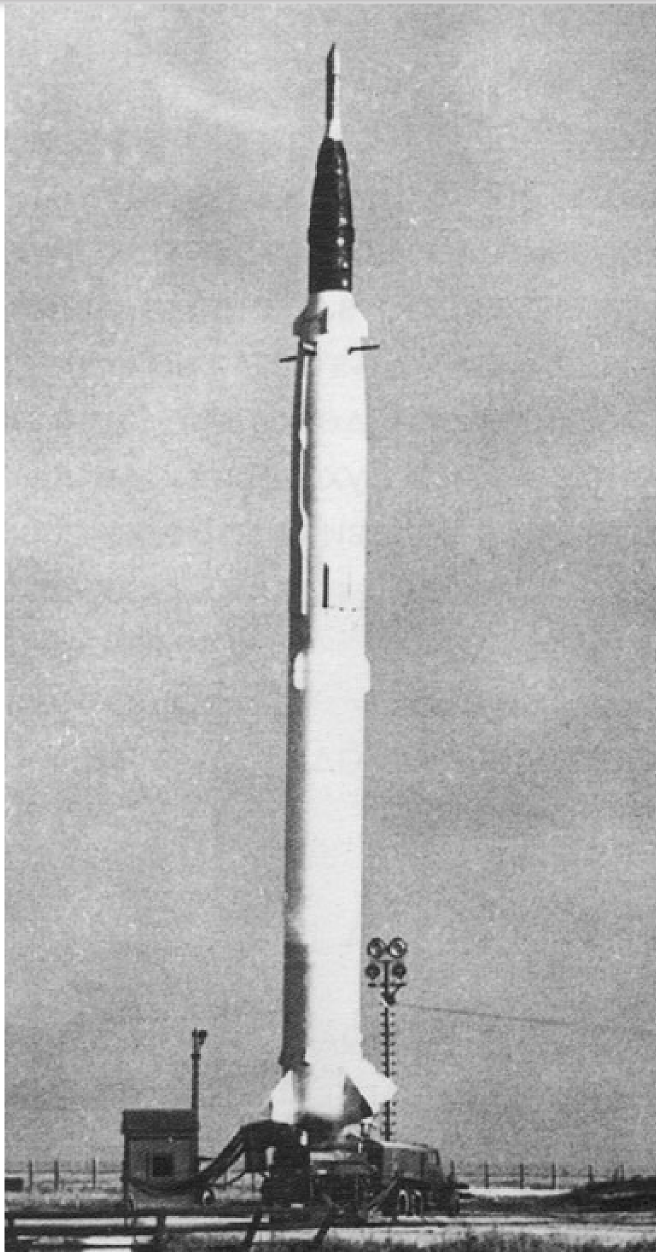
Soviet missile designer Sergei Korolev at the Kapustin Yar testing grounds in 1953.
—NASA's Asif Siddiqi photo

a Boeing 747 was modified to carry the Space Shuttle piggyback, all missiles and rockets could be no wider than could be supported by a 4-feet, 8.5-inch trackbed to transport them.

The limited width of the rocket dictates the size of its engine and how much fuel can be burned at any given time to produce thrust. In the United States, missile design was given over to using rocket engines stacked on top of each other in stages. This design fired the engines separately. The amount of thrust available was only the amount of the single burning engine. The end result was relatively little thrust, which limited payload size. Because of this design limitation, the US was technically challenged to develop lightweight materials and to miniaturize rocket components. Payloads had to be small.

Korolev was the first to consider the practical development of a rocket using clustered liquid fuel engines. Having first developed a successful medium-range ballistic missile, the R-5, based on a powerful single engine, he went on to successfully develop a missile guidance system accurate enough to deliver a nuclear warhead using the R-5M. Almost exactly one year earlier to this date, the R-5M was successfully tested with a nuclear warhead, thus giving the Soviet Union nuclear reach to 750 miles (as far as Germany). Discounting the US Army's Jupiter missile, the US Air Force's 1,500-mile Thor missile would not be ready for another year and a half.

From the success of the R-5, Korolev designed the Soviet R-7 missile, called Semyorka, to be the R-5 redesigned main engine surrounded by a cluster of four



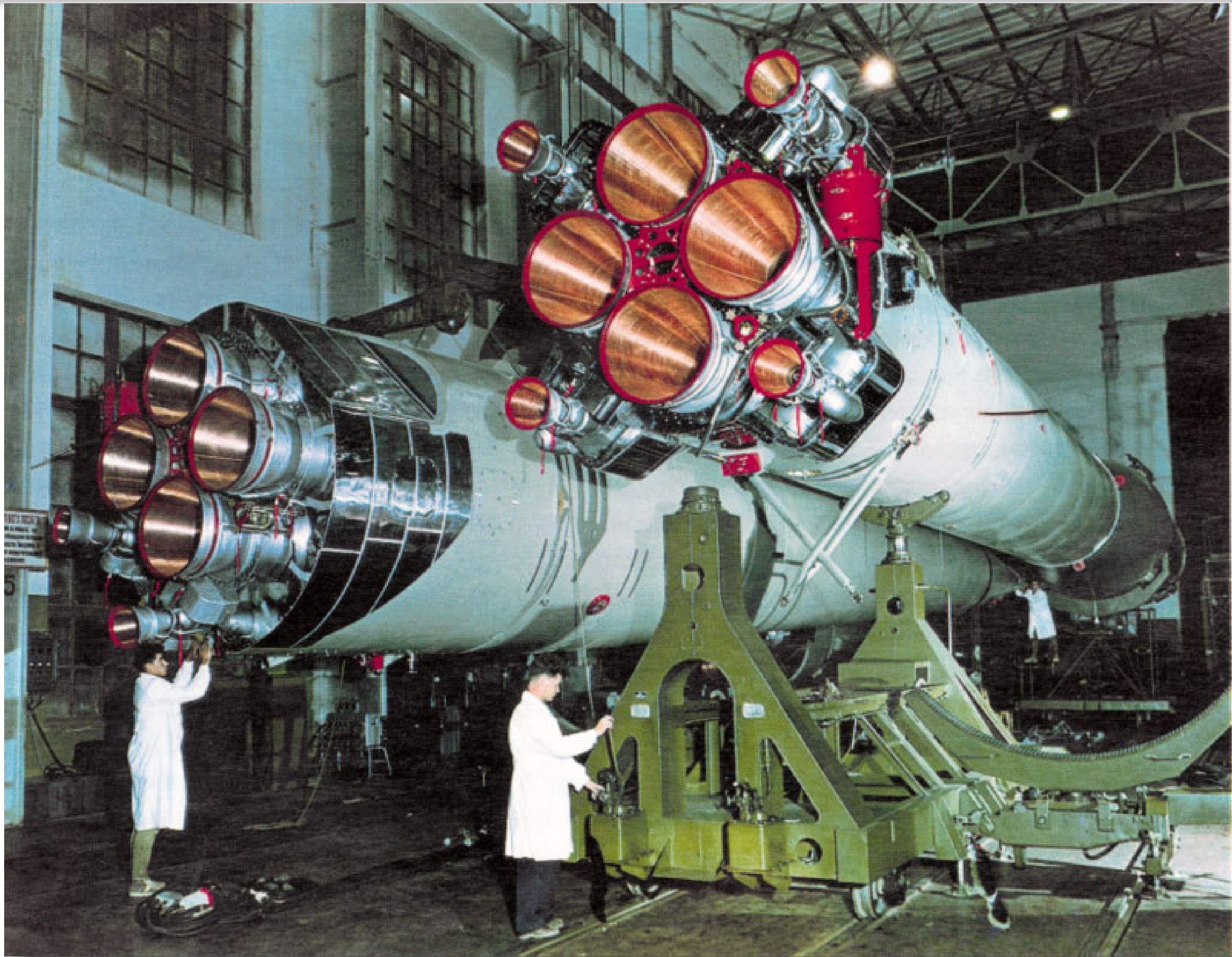
The R-5MA medium-range ballistic missile with single engine and heat-sink nosecone design.

—Energia photo

rockets, each with a four-chambered, four-nozzled engine and a separate set of swiveling steering rockets, called vernier rockets. This rocket design, the basis for spacelift design for the next 50 years, had to solve these engineering problems:

• Interior structure to support the massive weight. To overcome the tendency of the outer rocket tube to buckle due to the weight of the interior fuel tanks, the reinforced tube became the fuel tanks.

• Guidance system using vernier rockets. Rockets that primarily travel through the Earth's atmosphere can use fins and moving ailerons in the fins to let air rushing over these surfaces control flight. However, a rocket entering space cannot use airfoils for guidance. Until the R-7, this problem was solved by mounting the primary rocket engine on a pivot in order to change the direction



The R-7 main engine and a single cluster rocket engine showing the four-chambered throat surrounded by four gimbaled venier rockets for steering.

—Energia photo

of thrust. The United States adopted pivoted, called gimbaled, rocket engines in designs being built by the Navy and Air Force, and the Army used fins with ailerons for its first stage and spun the upper stages as a crude method of guidance once in space. Korolev was the first rocket designer to adopt smaller, gimbaled vernier rockets, pointed off-axis, to steer the monster, clustered rocket. Also, each of the sixteen vernier rockets had to be controlled by radio signals from the ground.

• Coordination of firing all rocket engines. Early tests showed that treating the structure of each cluster rocket as independent of the others resulted in uneven fuel depletion times and loss of precious thrust. The fuel tanks had to be internally connected in order to ensure all four rocket engines would burn all available fuel before shutoff.

The venerability of the R-7 for use in spacelift, shown here in 2001.
—Anatoly Zak, Russianspaceweb.com photo

• Simultaneous release of the cluster "stage." The R-7 was considered a two-stage rocket. The first stage was the central R-5 engine. The second stage was the combined cluster of four rockets. Both stages were fired at the same time while on the ground with engine shutoff occurring for the second stage 200 seconds before the first. An explosive bolt release system had to be developed that simultaneously released all four clustered rockets from the primary without disturbing its guidance.

Having successfully tested individual systems using modified R-5M bodies and also bench testing the release mechanism, all that remained was to assemble the first complete R-7 for its first free test launch.

Next Month: How the US's Atlas design challenged the R-7 for arms race supremacy.

March 28, 1957

On this day 50 years ago, the Year of the Space Race saw the technical completion of the Atlas first single-stage-to-orbit missile design completed by Convair's rocket designer Karel "Charlie" Bossart.

A challenge all rocket designers face is the more fuel a rocket carries, the more it weighs and the more fuel it takes to overcome gravity. The general rule of thumb for the 1950s said it took 25 pounds of fuel to move a single pound of missile dead weight. All rockets start slowly and gradually build up velocity as fuel is burned and the rocket weight diminishes.

The purpose of staging rocket engines, or having separate rocket engines fire in a sequence—one after another as each has depleted its fuel, is to throw away each stage as its fuel runs out and the stage becomes mere dead weight. After each stage separation, the rocket becomes lighter and it takes less fuel to move it.

Soviet rocket engine design was predicated on the very heavy weight of the Soviet Union's nuclear warhead. Because their purpose was to move a 6-ton warhead from the middle of the Soviet Union to the middle of the United States, Soviet rocket engines had to be so large that staging them sequentially was impractical. Therefore, Soviet spacelift has been designed around using clustered rocket engines from the very beginning.

In contrast, the United States, working from designs postulated by the father of Germany rocketry, Hermann Oberth, used the staged design as developed by Oberth's pupil, Werner von Braun.

Charlie Bossart in his Convair office.
—Lockheed-Martin photo

Von Braun's space launch vehicle used four stages firing in sequence.

Considered the Holy Grail of rocket designers is a rocket capable of single-stage-to-orbit. In this concept, the rocket is so efficient that it would take perhaps less than 10 pounds of fuel to move a single pound of missile dead weight. To develop such a design would involve technologies that greatly reduce the rocket's weight while retaining the structural integrity of its materials. Weight can be reduced by miniaturizing rocket component systems and by optimizing fuel weight per amount of thrust it delivers. Such a rocket design remains elusive today with only one rocket in history reaching this goal—the Apollo Lunar Module on its trip back to Earth from the moon.

Bossart's design for Atlas comes the closest to being single-stage-to-orbit, and it was accomplished using three radical techniques for the period:

• Gimbaled engines instead of fins. The German design used fins to provide rocket guidance, and the finned rocket design promulgated by science fiction remained the popular image for a rocket into the mid-1960s. However, fins must move in an air stream to have any effect, and space is airless. Bossart is one of the first rocket designers to mount rocket engines on a pivot, called a gimbal, in order to point it in different directions and thus change the direction of travel. Bossart perfected his gimbaled engine design in 1948.

• Retaining the staging concept of reducing weight when not needed by discarding two of the missile's three engines—while retaining the single fuel tank—after obtaining sufficient velocity.

• Reducing rocket skin and tankage weight. The internal fuel tank was constructed using thin stainless steel with minimal internal support. Unfilled, this "balloon" tank would crush under its own weight; so, it was necessary to keep it pressurized at all times using fuel or air to maintain structural rigidity. This pressurization caused additional design challenges for the rocket skin as will be explained later in the series.

Mercury-Atlas carrying the first American to orbit the Earth, Astronaut John Glenn, on February 20, 1962. Note all three engines firing as well as the steering vernier engine on the side.

—NASA photo

Critics note that since the design does "stage" the rocket engines if not its fuel tanks, the Atlas should be considered a stage-and-a-half design.

Holding Atlas back from having enough thrust for the Holy Grail was using kerosene as its fuel pumped at a very low pressure. In the 1960s, Bossart would design a two-staged Atlas with the upper stage Atlas Centaur engine to use liquid hydrogen instead of kerosene. This gave an unprecedented thrust not previously available. However, it would require technology not available in the 1950s to develop deep freeze components to keep hydrogen stored as a liquid and new materials that could withstand the intense cold of the fuel and the intense heat and force of its burning.

By a strange quirk of fate, Hermann Oberth would contribute to that design.

Oberth and von Braun discussing potential satellite orbits with Dr. Charles Lundquist.
—US Army photo

On this date, Oberth was a personal guest of Werner von Braun in the United States providing inspiration to the Army Ballistic Missile Agency's (ABMA) team. But Oberth was of retirement age, and he had not worked long enough for ABMA to be eligible for a civil service pension. Head of ABMA, Major General John "Bruce" Medaris, tried for a year to interest private donors in sponsoring a $75,000 annuity that would allow Oberth to remain in the United States. As successful as Medaris was in pleading for the funds that kept the Jupiter project alive, he was unsuccessful in getting donors to follow through on their pledges.

Informed his German professorship retirement eligibility would end if he did not return to Germany, Oberth was forced to abandon ABMA in November 1957, on the very eve of its success. Bossart and Convair hired Oberth under conditions that guaranteed a pension, and he returned to the US to work with Bossart in 1960. Oberth would in the future recommend using liquid hydrogen to his old pupil who would claim it was an unsafe fuel for NASA's manned space missions. Von Braun eventually was persuaded.

Atlas' three engines and verniers were lit while Atlas was on the ground even though the throwaway engines provided the majority of its thrust. Because of many failures of staged rockets to light upper stages in space, scientists were uncertain whether the airlessness of space hindered liquid fueled engines from lighting. This proved to be a matter of improving engineering technique rather than living with a limitation of science.

In the United States, three days earlier President Eisenhower and British Prime Minister Harold MacMillan issued a joint communiqué announcing the agreement to deploy the US's intermediate-range Thor missile in Great Britain. Eisenhower approved a revised Thor initial operational capability document identifying when Thor would be made ready: July 1959. The pressure was on Douglas Aircraft to get Thor successfully airborne in a record amount of time.

Next Month: Vanguard captures the lead in the space race and loses it again.

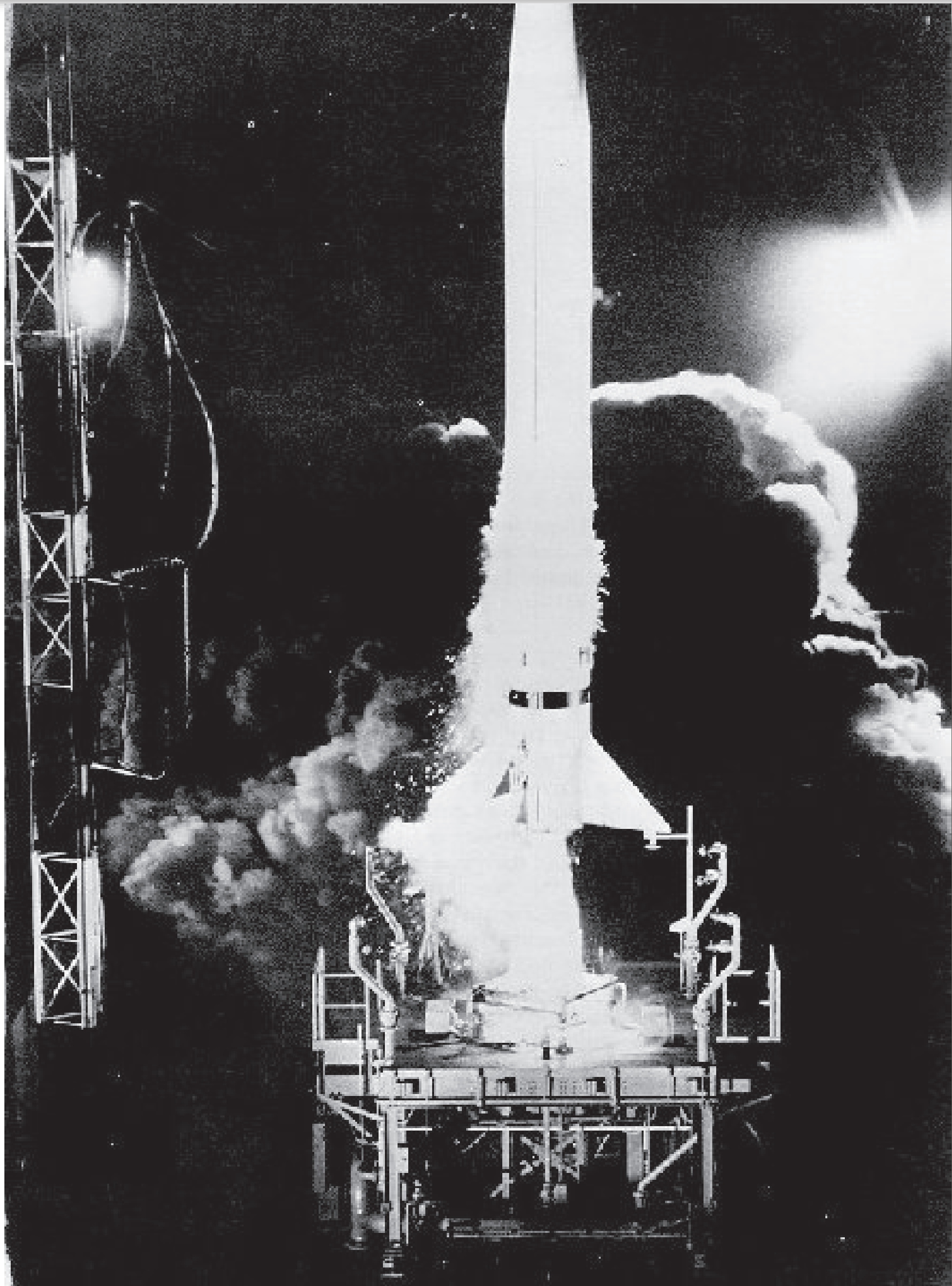
Atlas-A testing at Cape Canaveral in 1958 with the two throwaway engines firing at full thrust.

—US Air Force photo

April 26, 1957

On this day 50 years ago, the Year of the Space Race saw the completion of bench testing Vanguard Test Vehicle 1 and readying it for flight five days later. The flight of TV-1 on May 1, 1957, successfully met its objectives.

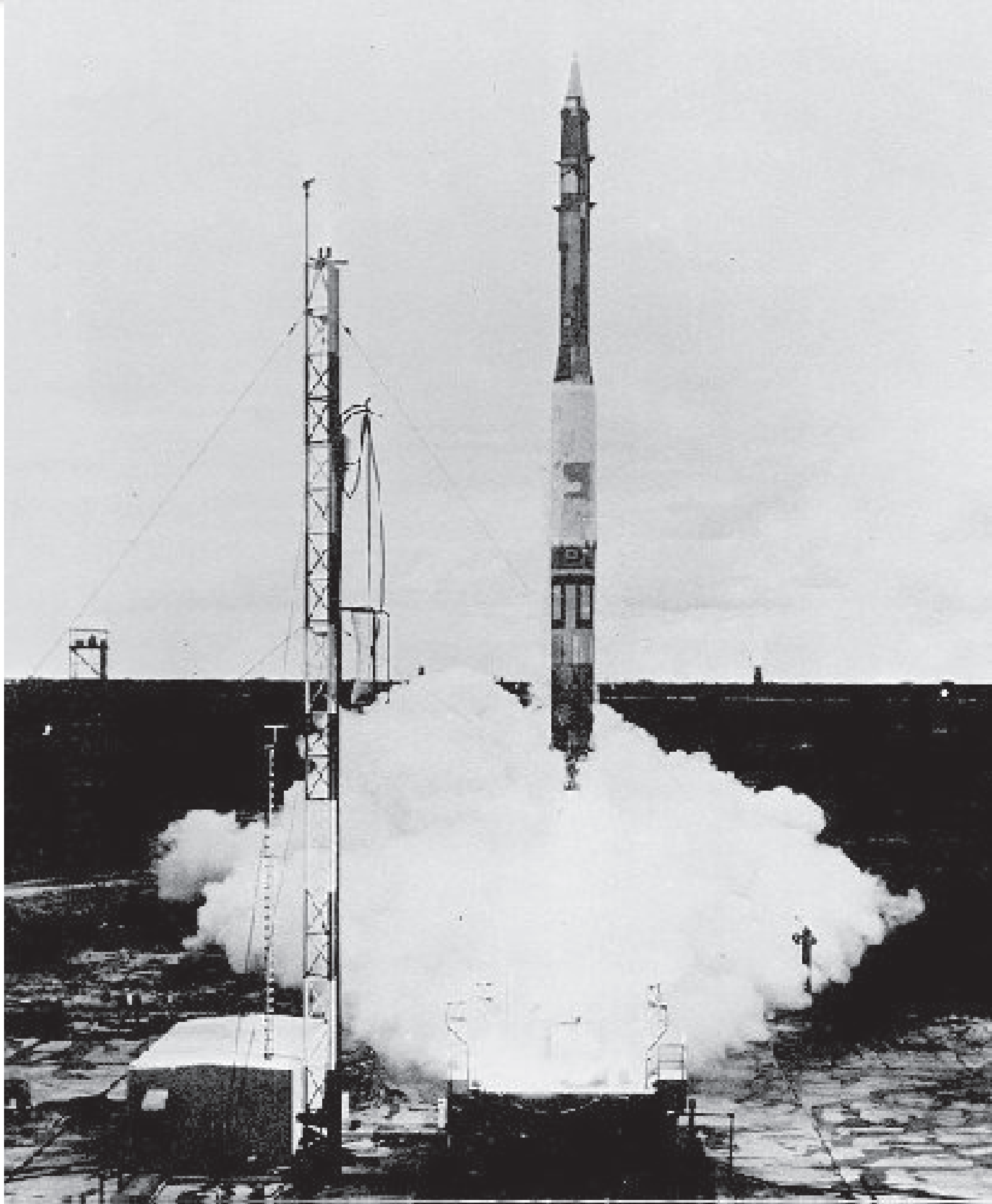
Vanguard TV-0 had successfully launched and tested Vanguard's main stage. TV-1 added a second stage to the primary, and testing was designed to ensure the sequence of staging events could be correctly accomplished. The second stage, the actual future third stage of Vanguard, was to become the satellite-bearing stage that would be rotated on a spinning table in the rocket to provide the stage's guidance (much like the Army rotated the top three stages of the Jupiter-C). As the second stage rose to an altitude of 121 miles, a Vanguard Project



Vanguard TV-1 launch on May 1, 1957. It was a modified Viking rocket (note the fins on the base). Compare with TV-2 on the next page.
—US Navy photo

engineer for the primary contractor Martin Missiles stated, “I wonder if success will spoil Project Vanguard,” since it was previously unheard of for the development of a rocket system to have such a string of successes.

Until now, the missile development rule of thumb was to take 5 to 8 years from inception on the drawing boards to the weapon’s initial operational capability—providing the weapon to its end user. As a modified Redstone missile, the Army’s Jupiter-C space race entrant was already in its fifth year of development. The Navy’s Vanguard was first designed in 1955 and then completely redesigned a year later. Its maiden test flight was the previous December, and its delivery date for early 1958 was an overoptimistic target. This proved to be ironic because Vanguard was handicapped to lead the US into space on the premise it would



Vanguard TV-2 launch on October 23, 1957. This represents the final 3-stage Vanguard design.

—US Navy photo

use an existing rocket and would not be hampered by a manufacturer working day and night to meet the priorities of producing a weapon for the arms race.

Unfortunately, Vanguard's successes became failures when forced to go from existing rockets in inventory to newly manufactured ones. Vanguard's TV-2 would become plagued with manufacturing errors largely due to poor supervision in the Martin main plant, already working overtime to get the Titan intermediate-range ballistic missile successfully airborne. Inspections at Cape Canaveral conducted by the Navy would uncover fine filings, metal chips, and dirt in the tankage and engine. This caused the return of parts to the Martin plant for rework and ultimately delayed the launch of TV-2. Because the Eisenhower administration had committed Vanguard to an early launch in 1958 to meet the requirements of the upcoming International Geophysical Year (IGY), all concerned with Vanguard would experience high frustration by the summer of 1957. Frustrated Canaveral Navy range boss Daniel Mazur fired off the following teletype to Martin officials:

"Rockets are large, rockets are small,
If U get a good one, give us a call."

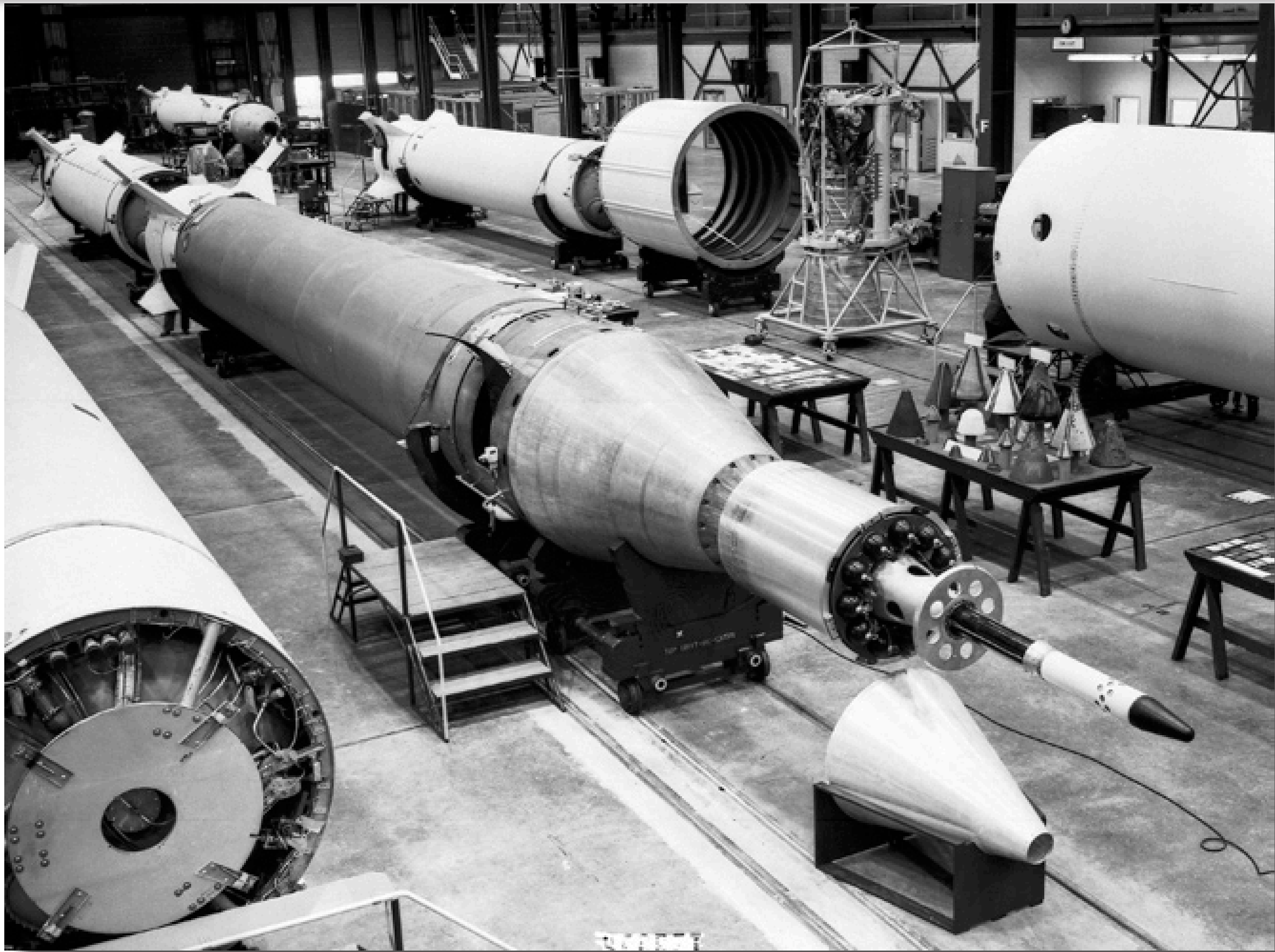
What compounded the Navy's and Martin's woe was the openness of the Vanguard Program. Every step taken for Vanguard was Monday morning quarterbacked by the world's top rocket designers.

• The US Air Force in developing the Thor and Atlas missiles was essentially experiencing the same kind of problems as Vanguard. However, because their work was classified, these problems were not subjected to public scrutiny.

ABMA's jet vest. Not all research and development yields practical fruit. Such projects are pursued out of the public's eye and do not risk criticism.
—US Army photo

Moreover, although the Navy took pains to publicly share the kinds of development problems it was having and the proposed solutions with the entire rocket community, there was little reciprocity.

• For the US Army's Army Ballistic Missile Agency, "been there, done that" best typified reaction to Vanguard's problems. Agency head Major General John "Bruce" Medaris would point proudly to his own organization's internal manufacturing capability that gave it independence from civilian contractors. Army contractor Chrysler played no role in the development phase, and it only had a production role after the system was fully tested. Also, the technical problems being experienced in developing essentially a new rocket from scratch were problems ABMA had already experienced with the Redstone missile and solved in a less scrutinized environment. Seething with righteous anger through 1957, knowing ABMA already had space launch capability and could launch a satellite with 90 days notice, Medaris reviewed Vanguard's development reports and was convinced



Jupiter-C skin number 27 under construction on the ABMA shop floor. This is the rocket successfully fired on its maiden voyage on September 20, 1956. Note the 11 solid fuel rockets in the upper second stage, the central shaft of the clustered three solid fuel rockets forming the third stage, and the single inert rocket fourth stage at the top. This entire assembly was spun in a "tub" on the rocket to achieve level flight.

—US Army Photo

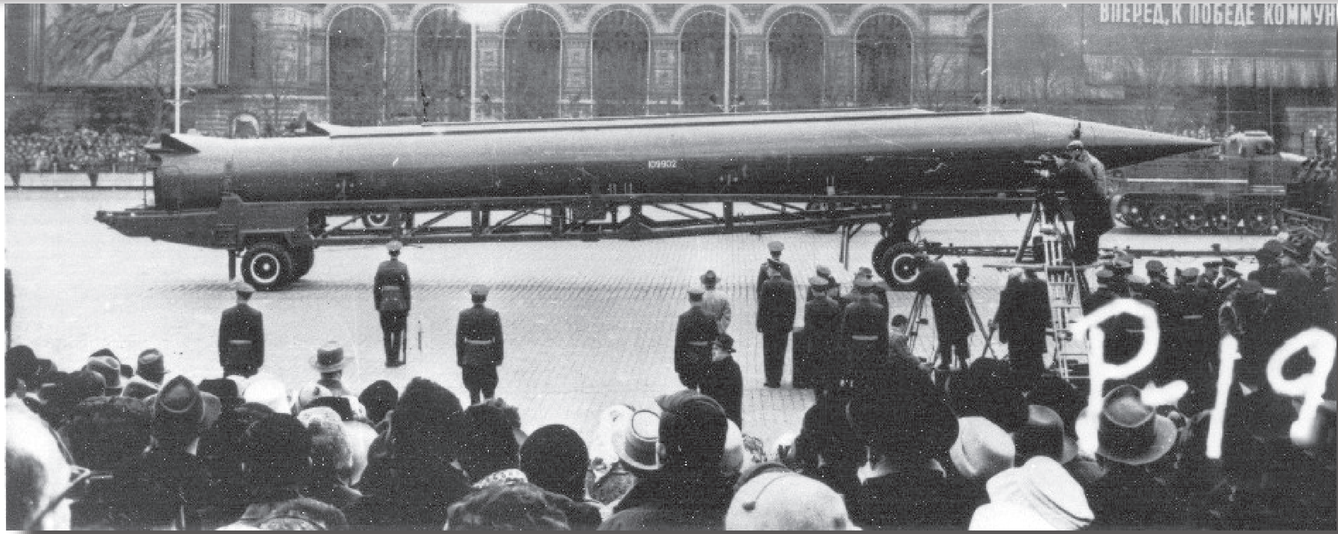
the Vanguard Program could not possibly deliver on its promise for IGY.

• During this period, Soviet rocket designer Sergei Korolev was involved in his own life-or-death internal struggle with rival designer Mikhail Yangel, and he was losing.

Next Month: Dark days for dark horse race contestant Sergei Korolev.

Medaris with Army launch director Kurt Debus in the Cape Canaveral launching facility in 1958.
—US Army photo

May 15, 1957



Declassified intelligence photo of the R-12 used as an exhibit during the Cuban Missile Crisis.

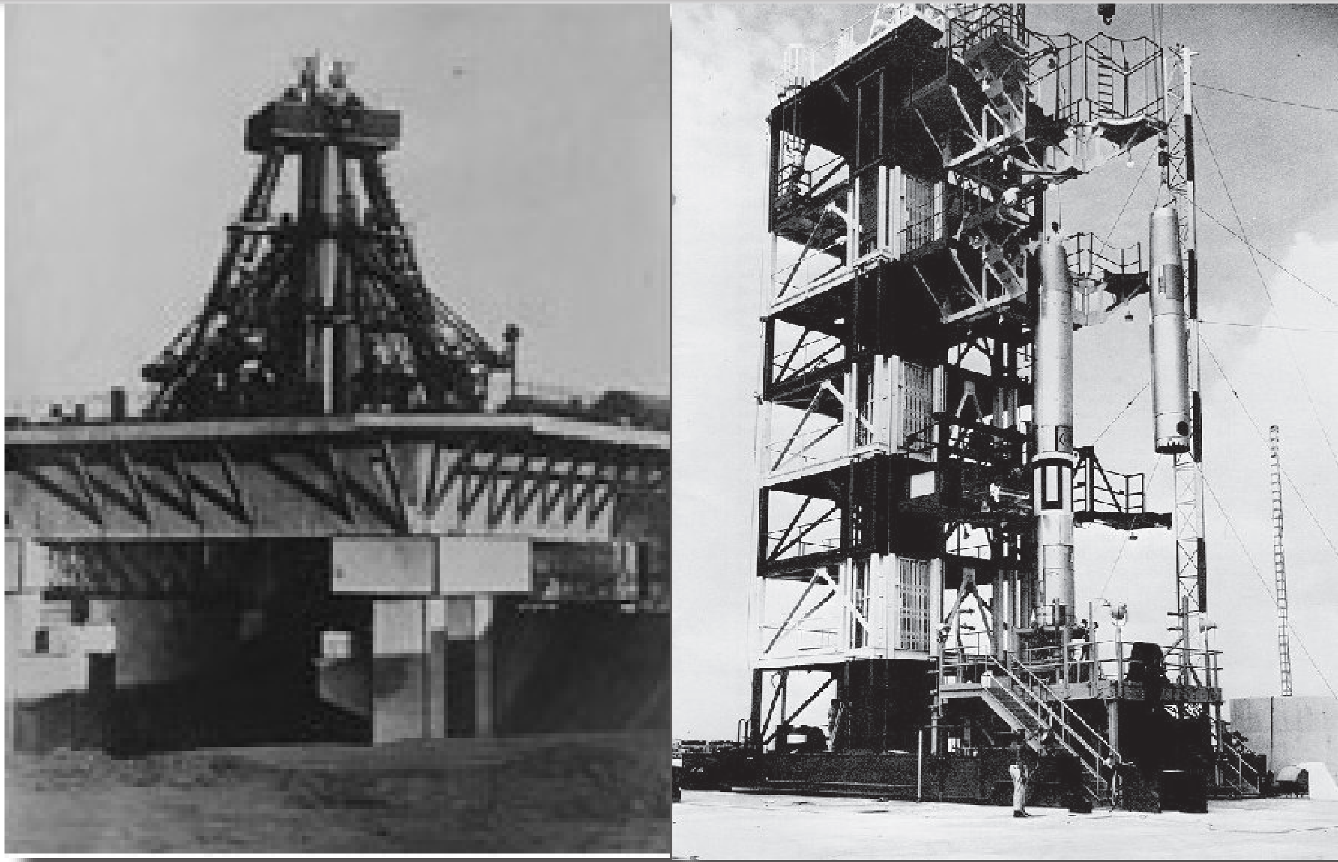
—CIA photo

On this day 50 years ago, the Year of the Space Race saw the maiden launch of the Soviet R-7 intercontinental ballistic missile (ICBM). After 98 seconds of perfect flight, one of the four booster engines in the cluster experienced premature cutoff and threw the missile into an uncontrolled, tumbling flight. This would prove to be the first of a series of failed launches, so common in the early history of innovative rocket design, but unsupported in the politically supercharged atmosphere of this year.

Two years earlier, the R-7 designer Sergei Korolev was the undisputed Soviet expert in missile design. Although Korolev was a workaholic like the other principle rocket designers of the day, it was unreasonable to saddle him with all Soviet development projects, and the Soviet Council of Ministers felt development work needed to be split into two separate production facilities under two separate management teams. A second facility was begun headed by Korolev's student Mikhail Yangel. Yangel was given the task of pursuing a new missile design, the R-12. Unlike the R-7, which used liquid oxygen as an oxidizer for burning its kerosene fuel, the R-12 would use two fuel components that exploded when coming into contact with each other. Called a hypergolic fuel, it could be stored in the missile indefinitely. Missiles using liquid oxygen could only be fueled immediately prior to launching because the extreme cold would destroy the fuel gaskets in time.

R-12 development and test flights were conducted simultaneously to the R-7's. The first R-12 test was conducted in June, and results were promising.

Previously in January, Korolev had published development milestones for the R-7 which committed the first R-7 free flight to be conducted in April. Following the success of the test, the R-7 would be used to place the world's first satellite into space in June before the opening of the International Geophysical Year (IGY) in July. Having missed this deadline, Korolev's launch attempt on this date already put him one month behind schedule. Since the launch was unsuccessful, additional testing was scheduled for June 10th, but component problems caused the test to be scrubbed by June 11th. The missile had been loaded with liquid oxygen, and canceling the test required not only that the fuel be removed but also all the engine seals to be replaced from the low-temperature damage. When finally launched on July 12th, the R-7 blew up and disintegrated after 32 seconds, sending debris 4 miles downrange.



The R-7 being assembled at its launch facility at the Baikonur Cosmodrome while Vanguard is being assembled at Cape Canaveral.

—Energia R-7 photo
—US Navy Vanguard photo

Fearing the US would launch its satellite in the opening months of IGY using the Army's Jupiter-C, Korolev now had to console himself to losing the space race. The R-7 program's lack of success was not only a blow from the standpoint of establishing a credible long-range ICBM defense, it began to look as though the Soviets would have difficulty delivering on their promise to launch a satellite during IGY. Desperate to meet both objectives, ministerial boss Dmitri Ustinov contacted Yangel for emergency consideration to use the R-12. To Korolev's relief, cooler heads prevailed. It was determined that since Korolev had a year earlier developed a technical solution for modifying the R-7 to carry a satellite instead of a warhead, and production of the solution was complete, the time it would take Yangel to modify the R-12 would not likely result in a successful first launch prior to solving the R-7's problems. Relieved from spacelift responsibility, Yangel went on to complete R-12 development in 1959, and the missile played an alarming role in the November 1962 Cuban Missile Crisis.

The Vanguard launch facility being constructed in 1957.

—US Navy photo

This was to prove the lowest point in Korolev's life. Working 18-hour days with his crew under the primitive conditions at the Baikonur Cosmodrome, he experienced many of the same supply problems being experienced by the Vanguard crew working in the swamps of Florida at Cape Canaveral.

The Vanguard crew felt that American patience with Vanguard would eventually run out and the Army would be given the nod to proceed. Strangely, the Americans felt no threat from the Soviet IGY commitment.

The Soviet crew treated the Vanguard Program as misinformation disguising the Army's proven ability to launch a satellite. None of them could imagine the Eisenhower administration would not fully use the Army's capability to launch a satellite before the Soviets could obtain a successful launch of the R-7.

For the crews of both nations, inner strength was required to face these hardships and to eventually overcome them.

Next Month: As Atlas debuts, intelligence and leaks set satellite expectations for the coming International Geophysical Year.

Anxious moments awaiting launch then news the satellite successfully reached orbit. Top photo shows Vanguard watchers. Bottom photo shows Werner von Braun with General John Medaris in the background.

June 11, 1957

On this day 50 years ago, the Year of the Space Race saw the first launch of the Atlas intercontinental ballistic missile. Designated Atlas-A, the missile followed in the footsteps of first tests for Thor and the Soviet R-7. After rising 10,000 feet, the booster fuel system failed and the missile was destroyed by the range safety officer. The second test flight on September 25th experienced the same failure 3 minutes into flight.

The Atlas-A launch at Cape Canaveral on June 11, 1957

—US Air Force photo

This series has already remarked that test failures are important in the natural development of rockets. The Grand Master of US rocket development, Werner von Braun, was an advocate of a very slow and cautious approach to sequentially and gradually build a rocket from the outcome of many tests. This approach was also planned for the development of the Navy's Vanguard, and several Vanguard test vehicles were planned prior to attempting to launch a satellite. The management effort for both Air Force programs, Thor and Atlas, initially advocated a fairly long development period prior to the date of initial operational capability. This cautious engineering approach was considered the only correct way until the events of 1957 tossed caution into the wind. Before the year's end, rushing missiles and rockets toward completion would drastically change the political landscape, emphasize the importance of espionage and military intelligence, and would cause the United States to completely revamp education and training programs for scientists and engineers.

The Army's rocket development team reads (and probably furnishes inside information to) the Space Journal here held by Hermann Oberth with Werner von Braun to the right.

—US Army photo

Locked in a fight-to-the-death arms race during this period, neither the United States nor the Soviet Union wanted any information leaked that would assist the other side. However, both governments' attempts to restrict the free flow of information during the Year of the Race to Space were thwarted by the race's participants. Leader of the Army's team, Major General John "Bruce" Medaris, had awakened New Year's Day with the unpleasant news he was to be questioned by the Army's chief inquisitor, the Inspector General, over continued news leaks made to Missiles and Rockets magazine. Medaris was successful in proving he had adequately cautioned his team against leaking classified information, and the leaks were traced to his chief of staff. However, the strong sense of unfairness among the Army team at being prohibited from launching a satellite and from not being given due recognition for its Jupiter intermediate-range ballistic missile accomplishments just ensured more leaks would happen. Medaris made it clear to Secretary of the Army Brucker he could control leaks if he was allowed to provide unclassified public relations information, and this position was strongly argued before Department of Defense Secretary Charles Wilson. Unsuccessful with Wilson, when Neil McElroy, formerly CEO of Procter & Gamble, became the new secretary, the Army team felt at last someone at the top could appreciate the value of public information and salesmanship. As months went by with no change in policy from McElroy, the Army's rocket development workforce would refer to him derisively as "that soap salesman."

Not only was rocket systems development being classified, scientific research was also not permitted to be published. Significant scientific experimentation associated with the shapes of nosecones (presented later in this series) was kept from publication from 1952 until 1958, and it was only published after it was clear from discussion with Soviet scientists that the principles were already known in the Soviet Union.

Soviet bosses were experiencing the same problems but on a lesser scale. Since the Soviet government controlled press releases, press leaks were never a problem. However, a Soviet goal in the Cold War was to have the world take the advances in Soviet science seriously. To do that, Soviet scientists had to be as free as their Western counterparts to attend world conferences and to make presentations at them. Although Soviet scientists were accompanied at these conferences by political officers meant to restrict what they said, by June, American intelligence was already made aware of the general location of the top secret Baikonur Cosmodrome and the degree of progress made by Soviet rocket designer Sergei Korolev.

The location of the Tyuratam site was carefully protected by having the mail sent to and from it directed to Leningrad and Moscow. In fact, after putting the first man in space on April 12, 1961, the Soviet Union was required to name the launch site to record the event with the International Aviation Federation. This created a great dilemma for the secretive Soviets. The site was christened as the Baikonur Cosmodrome to deceive Western intelligence into thinking it was located 180 miles away at the town of Baikonur.

But an official paper written by the Soviet Academy of Sciences and presented by Soviet IGY planners to the assembled IGY planning team this month predicted a Soviet satellite would be launched within months, gave the rocket's anticipated speed, and gave away the approximate location of the Tyuratam site.

U-2 Dragon Lady in flight. The aircraft is still in use.

—US Air Force photo

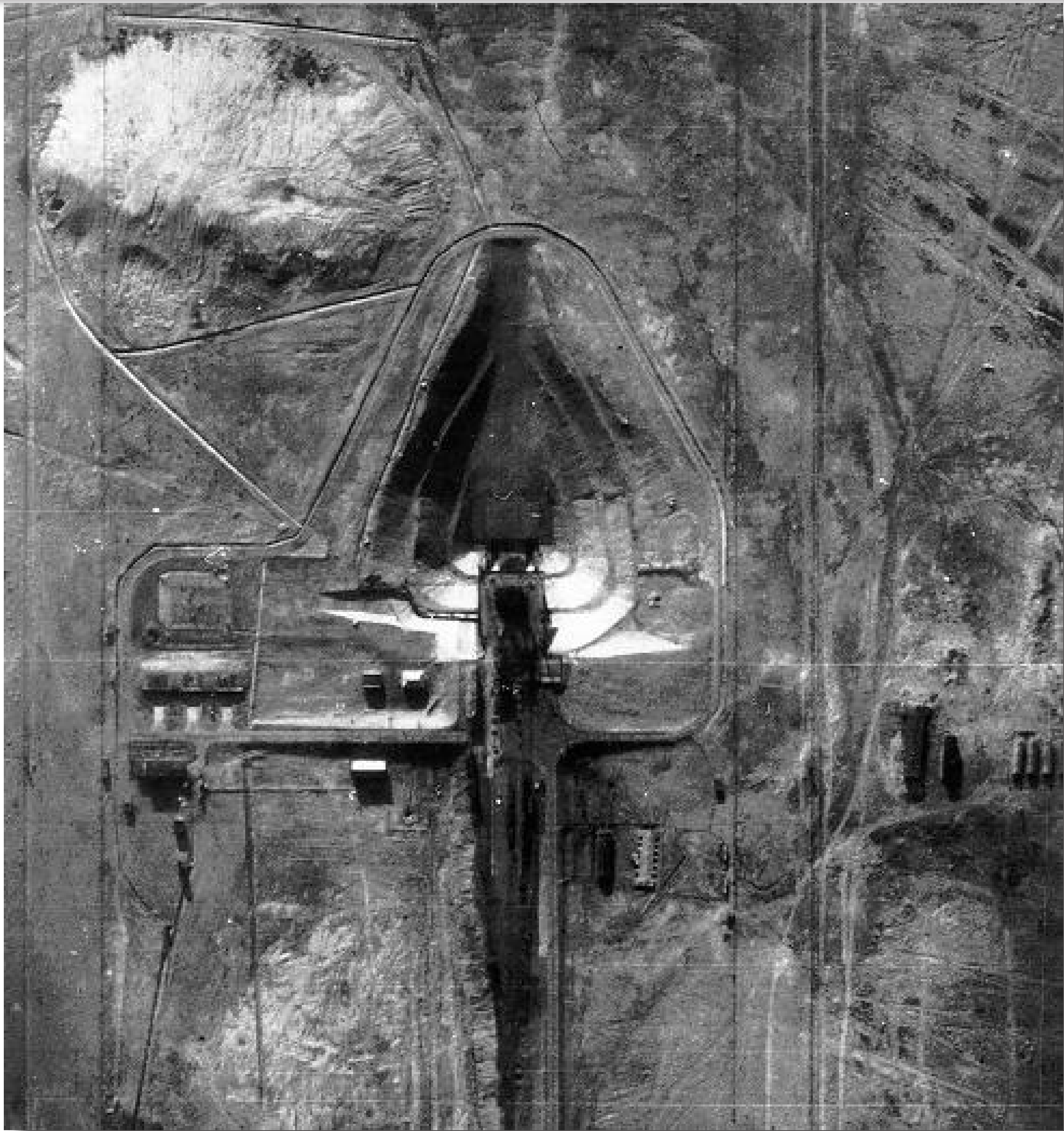
Learning from the one-upmanship being practiced by the American military services against each other, on August 27th a Soviet scientist at a Colorado conference bragged that the orbit of the Soviet satellite would be a more difficult-to-achieve higher inclined one and would broadcast on frequencies the world's shortwave radio enthusiasts could receive.

Western intelligence, working from intelligence from the June presentation, secretly sent U-2 spy planes into the general area to search out the secret launching site. Searching for the next two months, U-2 planes discovered the actual site in Tyuratam, Kazakhstan, in August. One of the CIA pilots involved in such searches was scheduled to photograph the Tyuratam facility on May 1, 1960, and acting on that intelligence, the Soviets rushed SA-2 surface-to-air missiles to Tyuratam to shoot down his aircraft. High cloud cover caused pilot Francis Gary Powers to be diverted to another location where his U-2 was shot down over Sverdlovsk, creating the U-2 Crisis of 1960.

Long before the U-2 Crisis, the Eisenhower administration agonized over whether or not national boundaries extended into space. U-2 flights violated Soviet sovereignty if boundaries extended into space. Scientists were already speculating on how international law might restrict orbiting satellites since orbits are unconcerned with boundaries on the ground. Tasked with providing high altitude pictures of nuclear explosions during Project Hardtack conducted in August 1958, the Army used RCA video cameras on Redstone missiles. Although working at relatively low altitudes, this set the stage for military imagery from space and the Corona project (discussed later in the series).

The launch of the first satellite, regardless of who won that race, would establish the principle of space being free from international boundaries.

Next Month: The International Geophysical Year opens to a Space Race in full progress.



U-2 photo of the R-7 pad at the Baikonur Cosmodrome taken in August 1957.
—Declassified CIA photo